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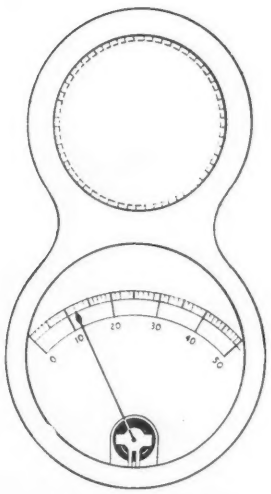

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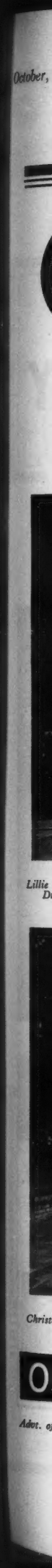

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Light and Lighting

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Principal Contents:

Public Lighting

THE Conference organised by the Association of Public Lighting Engineers last month was by general consent informative and enjoyable. Several excellent papers were presented, and the display of lighting, both gas and electric, arranged by leading firms in the lighting industry, in the streets of Folkestone well deserved study; the staff work, as usual, was good, the social events enjoyable, and the weather kind.

These annual conferences afford a good opportunity of pressing home the importance of good lighting and a pleasant meeting ground for all interested in the subject. They are deservedly popular.

Yet we must all confess that one of the main aims of the Association—the appointment of fully qualified and independent public lighting engineers in all cities and towns of importance—is still far from being satisfied. This point was strongly emphasised in Mr. Lennox's presidential address to the A.P.L.E. last year, and again in Mr. Cunnington's address to the Illuminating Engineering Society.

We hope that the issue of the final report of the M.O.T. committee on street lighting will encourage the Association to press this important matter strongly, and that at future conferences we shall hear a little more of the excellent work that experts of this type are already performing in their respective cities.

The Paris Exhibition—Lighting Developments in Australia—St. Michael's Mount (Cornwall) by Day and Night—I.E.S. North Midland Area Local Section; Opening Meeting—Engineering and Marine Exhibition—Forthcoming Events.

The Paris Exhibition

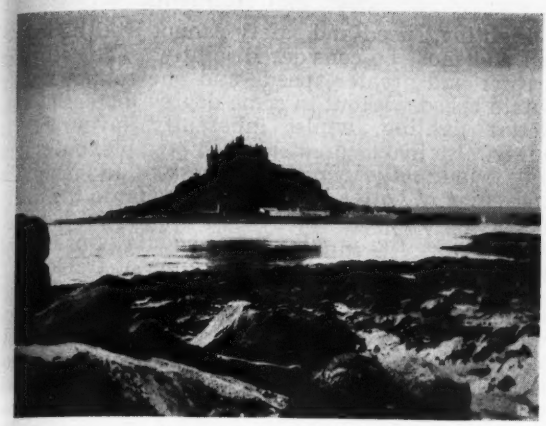
The party of members of the Illuminating Engineering Society, about two dozen in number, who visited Paris last month, were rewarded by a most entertaining glimpse of the International Exhibition, of which so much has been heard. We say "glimpse" because it would require a very much longer period to make even a general survey of the outdoor and indoor lighting. We hope to give a brief illustrated account of the visit in our next issue. For the moment we can only record that many of the exhibition buildings were most impressive and of striking design and that the view looking downwards from the Trocadero was one not soon to be forgotten. Naturally "concealed lighting" played a dominant role, but effective use was also made of luminous decorative objects, such as fireworks. The fact of the Exhibition being housed on the banks of the Seine enabled liberal use to be made of illuminated fountains, some very fine effects being shown. We would not like to let this opportunity pass of expressing appreciation of the great kindness of MM. Maisonneuve and Chappat, of the Compagnie des Lampes, and M. Maurice Leblanc, the President of the Association des Ingénieurs de l'Eclairage, who went to considerable trouble to ensure that the party saw the utmost possible during the short period of their visit. We advise other members to take the chance of seeing the lighting of the exhibition if it comes their way. We understand that the newly formed Decorative Lighting Section of the Society will deal with this topic at their opening meeting on November 9th (see p. 275).

Lighting Developments in Australia

The writer, in common with the President, was unfortunate in having to leave Paris on the Monday evening and thus missed the final event of the trip, the Festival of Light, which we hear was very fine indeed. He had, however, the great compensation of arriving in London just in time to greet Mr. A. Brown, the honorary secretary of the Illuminating Engineering Society of Australia, with headquarters in Sydney (N.S.W.). A welcome opportunity of discussing methods of co-operation between the bodies and their common problems was thus afforded. Our attention was drawn to the fact that January 20, 1938, will be the 150th anniversary of settlement in Australia, which will be celebrated in Sydney by great festivities, in which lighting will play a prominent part, during the early part of the year, and which will be followed by a Lighting Convention and Exhibition in June. Lighting experts from other lands have already arranged to attend the Convention. We do hope that our country will be well represented. A word to the wise, however. Sydney is likely to be very crowded. Therefore, anyone who hopes to make the journey should get in touch with Mr. A. Brown, secretary of the Illuminating Engineering Society (Australia), 1, Jamieson-street, Sydney, who will do everything possible to help.

We have also had a recent opportunity of meeting Mr. L. D. Wright, the senior Vice-President of the Illuminating Engineering Society of Australia (Victoria Division), and Mr. A. C. Pearse, who were present at the opening meeting of our own Society in London, and had interesting information to give us of developments in Melbourne. We wish every success to both these thriving bodies.

St. Michael's Mount (Cornwall) — By Day and by Night



We are indebted to Mr. George Herbert for the above two pictures showing the appearance of St. Michael's Mount (Cornwall) by day and by night. They illustrate, in a remarkable manner, how completely different is the distribution of brightness in the two cases. It is this variation which sometimes leads critics to condemn floodlighting as "theatrical" or "unreal"—though all that is really meant is the effects by day and by night are quite distinct. Mount St. Michael in Brittany has also been floodlighted recently. Like its British namesake it affords an excellent subject for treatment, though, of course, very much larger.

I.E.S. North Midland Area Local Section

Opening Meeting in Leeds

The above local centre—the most recently formed—has been the first to break the ice this year with its special meeting in Leeds on September 20. Councillor H. S. Sellars, who is a member of the Corporation Gas and Electricity Committee, presided, and there was a good attendance. Demonstrations of lamps and lighting equipment were arranged by a number of firms in the lighting industry, and an address was given by Mr. A. W. Beuttell (past president) who had come up from London for the purpose. The local centre has already acquired a substantial nucleus of membership, largely owing to the enterprise of its honorary secretary, Mr. J. W. Howell, and has mapped out an interesting programme for the session, which will be included in the General Programme to be circulated to all members of the Society very shortly.

Engineering and Marine Exhibition

Members of the Illuminating Engineering Society and kindred bodies paid official visits to the above exhibition on September 28. Mr. A. Cunnington (I.E.S. president) was amongst those who rendered thanks for the visitors at the luncheon. One missed the familiar figure of Professor Hele-Shaw, who has at length retired from the chairmanship of the committee of experts, but the genial general manager, Mr. F. W. Bridges, was once more on duty. Although the exhibition, naturally, did not contain many exhibits dealing directly with lighting, one met many firms familiar in the lighting industry "on other matters bent"—Philips Lamps, Ltd., for example, on welding equipment, and Chance Bros. on marvellous creations of spun glass. One also noted the effective gas lighting of the imposing stand of the British Gas Federation.

Forthcoming Events.

Oct. 12th. Opening Meeting of the Illuminating Engineering Society. Presidential Address and Exhibits *(E.L.M.A. Lighting Service Bureau, 2, Savoy Hill, London, W.C.2)*; Preliminary Inspection of Exhibits, **4.30 p.m.**; Meeting and Demonstrations, **5.30 p.m.**

Oct. 13th. Opening Meeting Scottish Local Centre of the Illuminating Engineering Society in Glasgow. Address by Dr. S. ENGLISH on **"New Angles on Street Lighting."** (*"The Gordon," 19, Gordon Street, Glasgow, C.1*); **7.30 p.m.**

Oct. 18th. Mr. J. F. COLQUHOUN on **Street Lighting** (North Midland Area Local Centre of the Illuminating Engineering Society). (*Electricity Showrooms, The Headrow, Leeds*); **7 p.m.**

Oct. 19th. Mr. A. E. ILIFFE on **"The Economics of Factory Lighting"** (Meeting of the Industrial Lighting Section of the Illuminating Engineering Society.) *(At the Junior Institution of Engineers, 39, Victoria Street, London)*; **6.30 p.m.**

Oct. 19th. Opening Meeting and **Exhibits** (North-Western Area Local Centre of the Illuminating Engineering Society). **Address on Progress** by Mr. A. CUNNINGTON (*College of Technology, Sackville Street, Manchester*); **7.15 p.m.**

Oct. 29th. Address by Dr. C. C. PATERSON, O.B.E., at the **Opening Meeting** of the Public Lighting Section of the Illuminating Engineering Society (*To be held in the New Illumination Extension of the Research Laboratories of General Electric Co., Ltd., Wembley, Middlesex*); **6 p.m.**

Nov. 2nd. Mr. J. CREAGH on **"Home Lighting."** (I.F.S. Local Centre of the Illuminating Engineering Society). (*Engineers Hall, 35, Dawson Street, Dublin*); **8.0 p.m.**

Nov. 4th. Exhibition of Lighting Fittings (Scottish Local Centre of the Illuminating Engineering Society). (*Royal Technical College, Glasgow, C.1*); **7.30 p.m.**

Nov. 9th. Addresses on the **Lighting of the International Exhibition** in Paris by Mons. J. DOURGNON and Mr. R. O. SUTHERLAND at the **Opening Meeting** of the Decorative Lighting Section of the Illuminating Engineering Society (*Institution of Mechanical Engineers, Storey's Gate, London, S.W.1*); **6.30 p.m.**

Nov. 12th. Mr. H. E. CHANCELLOR on **Gas Lighting.** (North-Western Area Local Centre of the Illuminating Engineering Society). (*College of Technology, Manchester*); **7.15 p.m.**

Nov. 15th. Floodlighting with Electricity and Gas (North Midland Area Local Centre of the Illuminating Enginering Society). (*Electricity Showrooms, The Headrow, Leeds*); **7.0 p.m.**

Nov. 16th. Mr. S. ANDERSON and Mr. W. R. STEVENS on **Lighting for Special Industrial Processes** (Meeting of the Illuminating Engineering Society and the Association of Supervising Electrical Engineers). (*E.L.M.A. Lighting Service Bureau, 2, Savoy Hill, London, W.C.2*); **6.30 p.m.**

Nov. 23rd. Dr. W. M. HAMPTON on **The Photometry of Projectors** (Meeting of the Photometry Section of the Illuminating Engineering Society). (*Demonstration Theatre, Holophane, Ltd. Elverton Street, Vincent Square, S.W.1*); **6.30 p.m.**

Lighting for Speed and Safety

Some Problems in the Lighting of Roads, Streets and Open Spaces

In what follows we give an account of the address given by Mr. A. Cunnington (President of the Illuminating Engineering Society 1936-37) at the Joint Session of the Society with the National "Safety First" Association on October 8th, and of the ensuing discussion.

There was an excellent audience at the Joint Session of the National Safety First Association and the Illuminating Engineering Society at the Park Lane Hotel on October 8, when Mr. A. Cunnington gave an address on "Lighting for Speed and Safety."

Mr. A. J. Lyddon (Deputy Chief Engineer of the Ministry of Transport) presided and opened the proceedings by a few sympathetic remarks on the importance of good lighting.

Mr. Cunnington, in commencing his address, recalled the fact mentioned by Mr. Langlands at the conference in 1935, that until recently public lighting authorities in England were under no positive obligation to light their streets. He also drew attention to the inequality arising when roads pass through the areas of different authorities, to the desirability that the lighting of national trunk roads should be dealt with on a uniform plan, and to the need for independent public lighting engineers in towns and cities of importance. On all such points the people were looking to the final report of the M.O.T. Committee for guidance. The lecturer also drew attention to another point of interest to local authorities and railways alike—the desirability of some more uniform method of charging for gas and electricity throughout the country.

Progress in Illuminants.

Turning next to illuminants Mr. Cunnington drew attention to recent progress on the electrical side, as represented by the performances of electric discharge lamps (operating at 45 lumens per watt in the case of the 400 watt mercury vapour lamp). Another recent step—the introduction of the smaller lamps, consuming 80 and 125 watts is, of course, of outstanding interest in connection with the lighting of roads, yards and open spaces generally (At a later stage Mr. Cunnington also made reference to advances in gas lighting, as demonstrated at the C.A.P.L.E. Conference at Folkestone, explaining that his address had necessarily been completed before the date of the conference and before these new lamps had been publicly described.)

Whether any special colour of light is definitely advantageous in regard to "visibility" is a question on which an open mind should be reserved for the present, especially in view of the large number of distinct phenomena involved. The use of fluorescent materials, which are excited by the ultra-violet radiation, and thus improve the colour of the light without undue loss in efficiency, is a helpful expedient, for one would certainly prefer an approximately "white" light, if this can be obtained without undue sacrifice of efficiency. In view of the definite allocation of certain colours for rear lights on vehicles and traffic lights, signals on railways, and similar purposes, a public lamp of a distinctive colour, green, for example, may occasionally prove inconvenient. Cases are on record both in this country and abroad of confusion with railway signals. Moreover, whilst it is true that at very low illuminations colours as such are difficult to identify, this does not apply at the comparatively high illuminations available in Class A, B and even C streets. Even when colours cannot be identified their obliteration by the special character of the light is surely a drawback because of the loss of gradation of tone or contrast which is apt to result.

Speed and Accidents.

Lighting, speed and safety cannot well be separated and must be considered jointly. The call is for greater and greater speed—and one cannot usually obtain speed without in some degree increasing risk. Better lighting, whilst inherently favourable to safety, also makes greater speed possible, but in this way it indirectly increases the risk of accidents. The first effect of better lighting is to increase the utility of a road, and one can only estimate its value for safety when the number of accidents is considered in relation to the speed and volume of traffic.

There is much less difficulty in showing that our present artificial lighting, or lack of artificial lighting, comparing as it does so poorly with daylight, does result in accidents by night becoming disproportionately large. Very instructive conclusions may be drawn from the Records of Accidents prepared by the National Safety First Association—for example, that in general the accident rate by night is at least twice that in the daytime. The proportion of accidents occurring during the hours of darkness has been increasing progressively for a number of years. This, of course, does not imply that our artificial lighting is constantly becoming worse but is merely a consequence of the fact that our roads tend to be used more and more by night.

The chart of frequency of accidents throughout the year, both in the streets and in industry, shows a well marked maximum during the dark winter months, being in fact reciprocal to the familiar daylight curve. Confirmation is afforded by data prepared by the writer in regard to accidents on railways. Even after making due allowance for fogs and other conditions which might be more adverse in the winter, it can be safely deduced that the greater frequency of accidents in the winter was definitely due to darkness. Improved modern lighting has also enabled a greater amount of shunting to be carried out at night.

Classification of Street Lighting Requirements.

But even if the close connection between lighting and safety is admitted, there is still need for a clear analysis of the various problems. Just how widely different are the various classes of lighting required to deal with the diverse traffic and street conditions is clearly shown in a recent analysis compiled by G. B. Van De Werfhorst, who draws a distinction between the lighting problems met with in city streets with slow traffic, residential streets with medium fast traffic, and arterial roads designed specially for fast traffic. The same author emphasises the need for illumination of the highway as well as the actual road surface, in order to eliminate the impression that might otherwise be formed automatically that no source of danger outside the lighted roadway can possibly exist. On second class roads beacon lighting may be provided, but at road junctions and other important points, higher illumination should be provided. Nothing is more dangerous than isolated lamps at considerable distances apart.

Technical Advances in Street Lighting.

Methods pursued by experts in the design of lighting installations are necessarily affected by changes in the materials. At present, the lighting expert can design lamps and lighting fittings but not the surfaces which they serve to illuminate. Surely the time must soon come when he will be consulted before the final decision on the matter of road surface is made. The general adoption of road materials which are always dark initially and soon also become highly glossy has led to a technique based on the study of reflected images of the illuminants, rather

than the distribution of illumination they produce. Distant objects on the roadway almost invariably appear darker than their immediate background. The most hopeful practice is, therefore, to aim at high and uniform brightness of the road surface against which all objects are seen in silhouette. This method applies mainly to highways on which road traffic is the chief consideration. On roads in residential and shopping areas the illumination of the objects themselves assumes more importance. If the aim of revealing objects in silhouette is observed on highways devoted mainly to fast motor traffic, the expediency of abstaining from the use of headlights except on roadways regarded as ineffectively lighted and in certain emergencies is evident. For the headlight illuminates the object to be seen and thus counteracts the purpose of the street lighting which is to render the object darker than its background.

Importance of Contrast and Background.

Visibility on the highway is largely a matter of contrast and of skilful design and location of sources of light. Road planning and road lighting should go together. The nature of the road surface is all important. For the moment, at any rate, gloss is a positive advantage, but it would be to the advantage of the lighting expert if a substance of lighter texture (e.g., a white "tar") could be devised, or a surface, whilst still polished, of a more granular character could be obtained. Attention has been drawn to the good qualities of the granite sets in Scottish cities, the facets of which reflect light at all sorts of angles, giving an effect of uniform brightness, which is retained to a remarkable degree after showers of rain. In the United States experiments have recently been made with road-blocks deliberately grooved to produce the same effect of "spreading" areas of brightness and reducing the "pools of darkness." Apparently a minute groove ($\frac{1}{8}$th of an inch) will bring about improvement. Again, the experiments with red granite, recently recorded, show that we are still a long way from any settled policy in regard to road surface.

Successful lighting of a road, or indeed of any open space, cannot be achieved by merely applying a preconceived plan. The lighting of a large shunting yard, where dangerous movements are constantly being carried on, requires attention to detail and much specialised knowledge. Similarly, a street-lighting engineer now attempts to survey a route in detail, recognising where bends in the road or important junctions demand a modification of uniform spacing and observing the danger spots where something should be done to improve contrast. There are often opportunities for little touches which may make all the difference to visibility—for example, simply whitewashing a fence at a bend of a road, or providing a light background to the summit of a hill behind which approaching cars may be hidden.

Contrast in Safety Devices.

We have in the now familiar white line a device which was originally regarded somewhat dubiously as involving too much upkeep, but which is now everywhere accepted as of vital importance. Light-coloured islands and guard posts are now becoming usual. Whitening the kerb might well be more widely adopted, both as a guide to the motorist and in order to serve as a limit promoting instinctive caution in the pedestrian. Whitening the edges of platforms or quays is likewise a valuable device in the interests of safety. Similar methods applied to stairways are equally useful.

Future Tendencies.

Whilst the conception of high and uniform brightness on the roadway will doubtless continue to be the main consideration in highway lighting for some time to come, other possible aids should not be neglected. Supplementary floodlighting from concealed sources may occasionally be helpful, even such devices as lights recessed in the kerb need not be dismissed as completely impracticable.

We should also not view with indifference the danger of glare that is always present when unshaded lights, or sources so designed as to throw a strong beam at angles slightly below the horizontal, are used. The extreme difficulty of securing adequate highway lighting with sources so few and so far apart has led experts to accept with resignation a degree of glare which is never contemplated in well designed modern interior lighting.

"Light on the object, not in the eye," ought to be our final motto out of doors, as it has long been indoors. Hence present technique in street lighting should be regarded as a temporary expedient rather than a final ideal—imposed by the meagre allowances of energy and expenditure at present procurable for lighting roads and open spaces. During the daytime our illumination is a fixed source and we must adapt ourselves to it as best we can. We often find ourselves facing the sun, but we know full well that we see in the greatest comfort when the sun is at our backs. In road lighting at present we face the light. We have still to attain the ideal of uniform adequate brightness, coupled with complete absence of glare.

In conclusion, Mr. Cunnington urged again the need for close co-operation of all parties in the interest of safety. Lighting should be thought of as inherent in the road design—as a definite part of the construction of the road.

The lighting engineer is ready with fittings that are improving almost from week to week. The road engineer is constantly developing his side of the work so as to produce really efficient roads. Would that the same progressive spirit prevailed when it comes to finding the money!

At the conclusion of Mr. Cunnington's address the ingenious and effective film produced by the B.T.-H. Research Laboratory, which is the subject of reference elsewhere in this issue (see p. 296), was shown. The film, which had been previously shown at the A.P.L.E. Conference in Folkestone, again proved a most successful demonstration and served admirably to illustrate many of the points raised in Mr. Cunnington's address.

The discussion was opened by Dr. S. English, who endorsed much that had been said in regard to the importance of contrast, but urged that a form of lighting from sources facing the observer, if properly controlled, ought not to give rise to serious glare. The lecturer was surely optimistic in visualising a system of lighting from behind!

Mr. F. K. F. Sawyer followed with some remarks on the importance of contrast and backgrounds at curves.

Dr. C. C. Paterson referred to the very substantial progress made during the past three or four years both in regard to the amount of light available and in establishing vital principles of street lighting. Lighting engineers could do all that was necessary—the only question was how much money could be allotted to furthering their plans.

Mr. J. M. Waldram suggested that concentration of light at angles slightly below the horizontal was an obsolete practice, not found in good modern installations. He was satisfied that lighting from behind would not work.

Mr. F. C. Smith urged that planning should not be based only on the consideration of straight roads. On roads with bends and gradients special care was necessary. Street lighting was not necessarily adequate because no accident occurred—it should be so good that the driver was free from apprehension and relieved from nervous strain. There was however, no royal road to perfect lighting, and room for different types of fittings, both of the cut-off and diffusing varieties. The principles outlined in the film were very sound, and he congratulated the designers. It had, perhaps, one drawback—of making the solution of road lighting problems appear too simple!

Mr. Cunnington, briefly replying to the discussion, said he fully appreciated the remarkable work that had been done during the last few years, and that the methods evolved were the only possible ones in present circumstances. But he looked forward to a time when more generous expenditure might open up new possibilities.

Councillor Alderman Thraves, Lord Mayor of Sheffield, moved a vote of thanks to Mr. Cunnington, the British Thomson-Houston Company, Ltd., and the Chairman; and in so doing alluded to the excellent work done by their lighting engineer (Mr. J. F. Colquhoun) in his well-equipped laboratory—all they wanted was *more money* in order to carry out their plans for better lighting.

The Chairman, in conclusion, urged that road engineers and lighting engineers should work together in perfecting their plans and in getting—what they both wanted—MORE MONEY for the execution of them.

The Principles of Road Lighting

In what follows we give a summary of an interesting analysis of the aims to be kept in mind in lighting X Class I, Class II, and Class III roads, contributed recently by Prof. G. B. Van der Werfhorst to the "Philips Technical Review."

In a recent instructive article on the above subject in the "Philips Technical Review"* Professor G. B. Van der Werfhorst included under the term "public lighting" lighting installations on public highways, squares, roads, bridges, viaducts, and subways provided for the convenience of road traffic. The methods to be followed naturally depend upon the character of the thoroughfare to be lighted.

Even in regard to the general principles of public lighting there is no consensus of opinion—which is natural when it is recalled that public lighting is usually left in the hands of local authorities, each having an individual opinion of its own. Of the luminous flux provided in all countries at least 30 per cent. is directed upwards to the sky. The appearance of the lighting unit during the day is often considered more important than the illumination furnished by night. In most cases standards are only 13 to 16 ft. high—a height determined by early considerations when the length of the lamplighter's pole was limited to about 16 ft.

Objects of Exterior Lighting.

Exterior lighting may be divided in various ways; e.g. (a) it may be regarded as intended to illuminate the surroundings so that they can be distinguished, or (b) the illuminant may be intended to attract the attention of the user and to serve as a signal. Lamps, again, may be provided for the safety, convenience, or pleasure of users as a whole, or they may be installed for private and personal reasons. In the author's analysis it is assumed that public interest has precedence over purely private considerations, and that safety and benefit are given priority over convenience and artistic effect.

In this article Professor Van der Werfhorst confined himself to the lighting of country roads outside built-up areas. In Class I. roads of this nature motor traffic, which should be able to travel at speeds up to 50 m.p.h., is the main factor. Bicycle traffic is also a factor in countries where no separate cycling lanes are provided, and slow-moving vehicles, if not prohibited, must also be given consideration.

One cannot depend on the lighting equipment of vehicles to provide adequate illumination of the highway, for however efficient this illumination may be it will inconvenience road users travelling in the opposite direction to such an extent that safe driving is impossible. (Roads having two traffic lanes have not been in use long enough for definite conclusions to be drawn for this type of highway.) The road must therefore be illuminated by permanent lighting units.

* Vol. 2, No. 4, pp. 110-111.

THE AGHA PIER AT ALGIERS.

The lighting of this pier, 20 acres in area, 7½ acres of which are roofed in, is illuminated entirely by sodium lamps. Sixty-one 65-watt "Philora" lamps are used. The units are mounted 33 ft.—36 ft. high, and 100 ft.—130 ft. apart, so that the spacing-height ratio is approximately 3 to 1. Very even illumination on the roadway is thus secured, and the wharves and frontages of buildings are also strongly lighted.

Observation of Distant Objects on the Highway.

The eyes of a motorist travelling at a high speed are directed far to the front, but move up and down through a small visual angle, so that the field of vision contains only a small cone in which foveal vision is continuously maintained. Yet his eyes are now and again directed to the nearer field. At a speed of 50 m.p.h. the eyes are focused on a point at least 300 to 400 yds. ahead—provided the conditions of illumination of the field of vision permit. If the eye is focused on a nearer point the road surface and kerb appear with too high a relative velocity and vision becomes very fatiguing—a condition opposed to safety of driving. All objects within 300 yds. are viewed peripherally, unless they are accidentally located within the small foveal cone. It is sufficient for the driver to become aware of the existence of an object at a distance of 300 to 400 yds. Recognition of its special nature is not immediately necessary, for fourteen to eighteen seconds must elapse before the object is reached, which is ample time for performing his subconscious manipulations.

Illumination of Kerbs and Pathways Essential.

If a Class I. road is lighted so that *only* the road surface is illuminated danger may arise. If the road edges are left dark the road user receives no peripheral stimulus, and this leads to the dangerous conclusion that no obstacle may arise from these boundaries. Illumination of the kerbs and pathways skirting the highway is not a waste of light, but an indispensable necessity.

Now the eye possesses the remarkable ability of ignoring and not registering any sensation due to an apparently useless stimulus. Many highways are still illuminated by unscreened lamps at distances of 60 and 70 ft., and at a mounting height of 16 to 20 ft. As a result of the glare a driver on such a road observes, in passing each lamp, dark patches appearing and disappearing alongside the traffic line. A driver comes to recognise that these stimuli do not arise from real obstructions, but are only the play of shadows. Unconsciously he suppresses all reaction to such stimuli, and he may still do this when a real obstacle appears. The collision which then occurs

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is not due to careless driving, but to the deceptive nature of the lighting—all the more deceptive the greater the experience of the driver and the better he knows the road.

The peripheral area up to 300 yds. ahead must be so lighted that each obstacle produces a perceptible stimulus, and the whole field of vision must be so illuminated that no deception or false interpretation of shadows is possible. Furthermore, the lighting must provide the driver with adequate means of foveal vision as soon as a peripheral stimulus has excited his attention.

Lights Should be Inconspicuous.

In the case of Class I. roads the lighting of the road itself and its immediate boundaries is the main consideration. The type of lamp is a secondary matter and it is desirable to make it as inconspicuous as possible. The method of lighting has none of the characteristics of light-signals or indicators. Illuminated signs or private lighting units should take second place. If vehicle lamps are so bright as to reduce the maximum efficiency available they should be either prohibited or restricted so that they are no longer a nuisance. Unless these restrictions can be enforced nothing definite can be achieved and it is impossible to install lighting on Class I. roads which will completely satisfy the specified requirements.

When all these conditions have been met, a short interval of 0.3-0.5 sec. must, under the best conditions, elapse before full recognition of an object takes place. During this interval a motorist travelling at 50 m.p.h. will traverse a distance of 22 to 37 ft. Nothing that happens within this interval can be utilised to judge the efficiency of the lighting scheme or has any bearing on the lighting. In order to conform with official regulations a vehicle, when travelling at 50 m.p.h., should be able to pull up in 74 yds. This means a total travel of 74 yds. after the obstacle has first been detected. In no case could the lighting be required to prevent a collision within this distance, which depends on factors quite extraneous to the illumination, so that such an accident could also take place in daylight.

The type of illumination required on Class II. roads outside built-up areas depends on their importance. If this justifies lighting of the kind prescribed for Class I. roads, then the remarks made above again apply.

Where "Beacon Lighting" is used.

But if this is not the case—if, for example, the volume of traffic is too small to justify Class I. treatment—it becomes necessary to require vehicles (and bicycles) to carry lamps, and the permanent lighting should now serve as a species of beacon lighting. The nature of the lighting scheme is thus radically altered. The lamp itself must now be visible, whilst the actual illumination of surroundings is a secondary matter. The brightness of the source should be low so that it never produces pronounced glare. The lighting should follow all bends of the roads and indicate their position and direction. At special points which are to be made conspicuous, such as road junctions, canal crossings, etc., a more powerful beacon should not be installed, as is frequently the case. This practice tends to concentrate the attention of the road user on the lamp itself instead of on the dangerous point. Instead of this the surroundings should be extra brightly illuminated, and the lamps used for this purpose should be as inconspicuous as possible.

On Class III. roads where an unbroken line of beacons would prove too costly, no permanent lighting is provided. Nothing is more dangerous than isolated, unscreened lamps at considerable distances apart, which are apt to deceive the road user and detract from the utility of his own lamps. For the demarcation of special points the methods recommended for Class II. roads should again be applied.

Fig. 1. The famous Sydney Bridge, illuminated by means of batteries of projectors, equipped with mercury discharge lamps, placed at the base of each pylon.

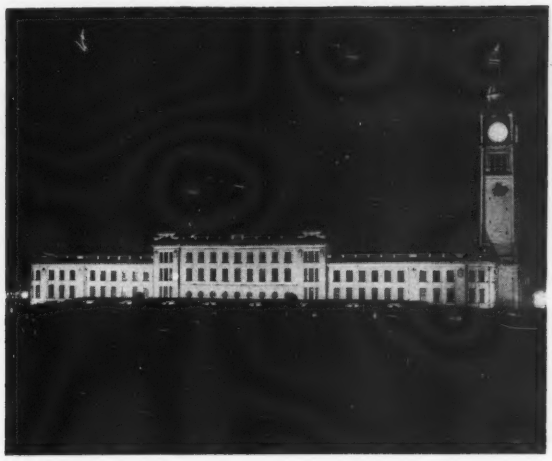


Fig. 2. The Central Railway Station, a building in yellow freestone, illuminated by sodium floods.

Coronation Floodlighting in Sydney

Mr. A. P. Turnbull, Electrical Engineer to the New South Wales Railways, in expressing his keen interest in our recent account of the Coronation illuminations in London, has been kind enough to send us pictures of some striking installations in Sydney. He confirms the need for discretion in order to get really fine effects, especially when coloured light is used. Some of these installations, whilst striking in effect, aroused some adverse comment. The famous Sydney Bridge, which is painted dark grey, was by some considered too ghostly by the greenish light of mercury lamps; whilst Fort Macquarie, a red brick building, when illuminated by discharge lamps giving red light, was "truly ruddy"! Possibly a judicious mixture with white light, which proved useful at Hampton Court, may be attempted on another occasion. The floodlighting of Government House and the Anzac Memorial were carried out by the Public Works Department under the direction of Mr. L. Yates, whilst the illumination of the bridge, the central railway station, and Fort Macquarie, were entrusted to the Chief Electrical Engineer for Railways. Sydney, like London, has profited from its experience this year. A chance of doing even better will be afforded in 1938, when the 150th anniversary of settlement in Australia is to be celebrated (see p. 275).

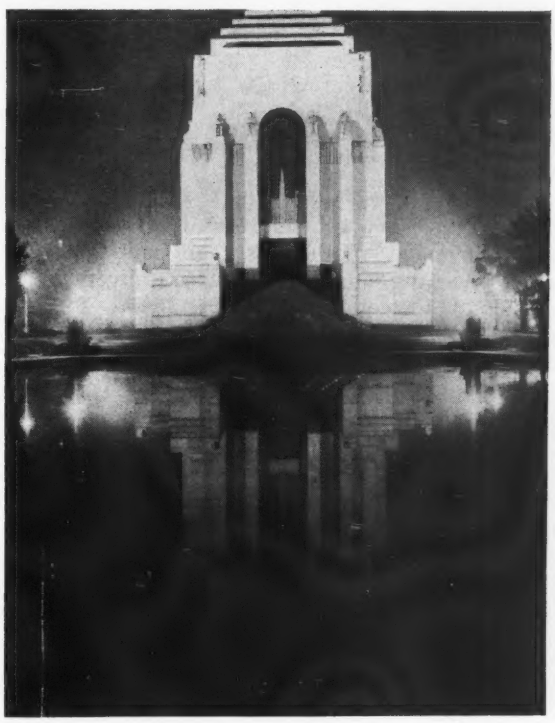


Fig. 3. The Anzac Memorial in Hyde Park, illuminated by white light.

Fig. 4. Government House, an old well-weathered freestone building illuminated by white light, made a fine appearance with its surround of trees and shrubs.

Fig. 5. Fort Macquarie, a red brick building, illuminated by electric discharge lamps yielding red light.

Progress in Public Lighting

Developments at the A.P.L.E. Conference held in Folkestone during September 6th—9th.

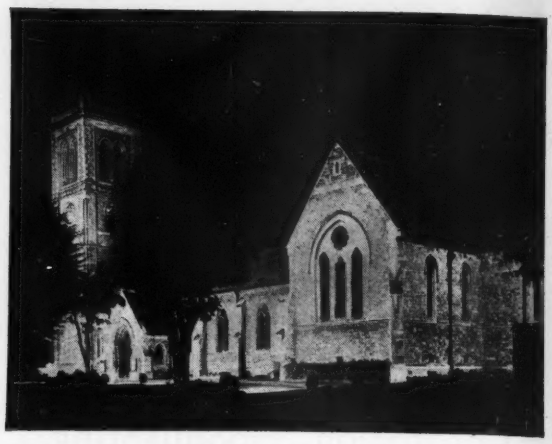
Fine Weather and a Record Attendance The new President's Practical Address—Papers reviewing Progress and Principles Mr. Foot's Speech at the Luncheon—A Fine Display of Street Lighting—Sir Philip Sassoon at the Annual Banquet.

The annual conference of the Association of Public Lighting Engineers, which took place in Folkestone during September 6-9, was favoured by brilliant weather, and the attendance, reported to exceed 700, was surely a record. As usual, there was a pleasant social programme, one memorable event being the visit to the delightful gardens at Lympne of Sir Philip Sassoon, H.M. First Commissioner of Works, who was the principal guest of the Association at the banquet.

Another item one might single out for special mention was the excellent address of Mr. R. W. Foot, general manager of the Gas Light and Coke Company, who presided at the luncheon given by the directors of the company on September 7—following which Mr. Foot was presented by the Association with a memento of the occasion.

The address of the new president, Mr. C. W. Winstone, was of a very practical character, and raised a number of important issues. The various papers, which were equitably shared between representatives of gas and electric lighting, led to keen discussion.

Perhaps the most distinctive feature of the conference, however, was the display of gas and electric lighting in the streets of Folkestone, some of the gas lighting installations on this occasion being of special interest. The headquarters of the hotel conference (the Royal Pavilion Hotel) were floodlighted by gas and embellished by a luminous sign utilising the new high-pressure decorative gas mantles for decorative lighting, and there were other pleasing floodlighting installations.



Christ Church, floodlighted with a mixture of Siemens Sieray electric discharge lamps and tungsten filament gasfilled lamps. For the body of the church 750 watt filament lamps in Royston floodlights were used; whilst 400 watt Sieray "H" lamps were used for the tower.

Valuable aid was given by the leading firms in the lighting industry, both gas and electric, who devoted a considerable amount of work to these installations as well as the preparation of papers: one should also not omit to acknowledge the efforts of those on the spot, the "lighting chiefs" of Folkestone (Mr. P. G. Hobbs, the electrical engineer, Mr. G. Le B. Diamond, the gas lighting manager, and Mr. E. L. Allman, the borough surveyor), which had so much to do with the success of the conference.

We note that Mr. C. H. Woodward has been elected vice-president of the Association, and understand that the next gathering is to take place in Bournemouth.

Courtesy: The Gas World.

The "Coronation" Flower Bed on the Leas floodlighted by Sugg gas lamps; a pleasing example of effectively lighted carpet bedding.

Presidential Address

by C. I. Winstone

Thirty-eight years' experience of Public Lighting —Advances in Gas and Electric Lighting—Two Striking Predictions—Differing Schools of Thought —Sufficient Illumination at Various Speeds of Driving—Test of "Night Seeing"—Pooling Expenditure on Public Lighting — Focussing on the Test-Point—Allowance for Depreciation—The Value of Photometers—Public Lighting a "Man's Job."

In his introductory remarks Mr. Winstone declared, with justice, that lighting engineers could claim to be members of a very old and time-honoured profession. He mentioned, incidentally, that he had been associated with the public lighting department of his company for thirty-eight years. At that time one cubic foot of gas, burned as a flat flame, produced 25 lumens, and one watt of electricity in a carbon filament electric lamp about 3.5 lumens. To-day the latest types of low-pressure gas lamps would give 300 lumens and the high-pressure lamps 364 lumens per cubic foot—an increase of 1,450 per cent. Similarly, a modern tungsten filament lamp would yield 16.8 lumens per watt, and some forms of electric discharge lamps as much as 55 lumens per watt—an increase of 1,570 per cent. Truly remarkable achievements!

Prophetic Utterances.

Two striking instances of foresight were quoted. Mr. J. Swinburne, some years ago, ended an address to the Illuminating Engineering Society with the suggestion that the next great step might be the utilisation of some form of electric discharge, whilst Mr. W. J. A. Butterfield, at the same meeting, concluded by predicting, as one of the next stages in gas lighting, the development of burners which were self-lighting without a by-pass. Both predictions have been fulfilled

Mr. Winstone went on to point out, however, that scientific distribution of light did not always keep pace with advances in production. For instance, one could often see a bright halo over distant cities, and one found on arrival that this was mainly due to light from public lamps emerging above the horizontal.

In regard to principles of street lighting there were two schools—one advocating a complete cut-off, the other a visible bright source. A happy medium preventing waste, but also avoiding the dull appearance of roads with no visible light source, seemed desirable.

What is "Sufficient Lighting"?

The decision as to what constitutes a "sufficient illumination" is a difficult problem. To people with normal vision a road lighted to "Class D" classification gives ample illumination for night driving without headlights—but there are some people who, although good drivers in the daytime, cannot see properly even by Class "C" illumination at night! Every driver should be compelled to pass a "night-seeing test." In the case of many night accidents it might well be the drivers' eyesight and not the lighting that was to blame. At some speeds, surely, no degree of illumination can confer complete safety.

What, then, is a safe illumination for varying speeds? Mr. Winstone suggested that:—

A generous "F" classification of 0.07 foot-candle is perfectly safe up to 40 m.p.h.

An "E" classification of 0.1 foot-candle is safe up to 50 m.p.h.

A "D" classification of 0.2 foot-candle is safe up to 60 m.p.h.

provided that there is also good visibility. Under these conditions one could easily pull up within the distance one could see.

Pooling Expenditure on Public Lighting.

There are, however, many miles of main road lighted to "D" classification and many more below "F"—even lighted so badly as to be below the range of a photometer at the test points. With one central authority would it not be possible to light satisfactorily many miles of roads, main roads at present either badly lighted or not lighted at all, by cutting down the lighting on roads extravagantly lighted? Mr. Winstone remarked that he knew certain roads bathed in brilliant light from dusk to dawn which did not carry twenty vehicles per hour after 1 a.m. The "pooling" of costs of public lighting would also help to relieve the poorer districts.

Mr. Winstone turned next to the vexed question of road brightness versus test-point illumination. In this connection he pointed out the danger that lighting engineers, in order to satisfy the specification as economically as possible, have sometimes adopted the practice of focussing the light on test-points to the

An Interchangeable Gas Sign

The gas sign shown in the photograph made a most effective setting to the entrance of the Royal Pavilion Hotel, Folkestone, at which this year's A.P.L.E. Conference was held. The sign is a development of the novel application of incandescent gas lighting introduced this year by the South Metropolitan Gas Company.

The essential feature of the device is the combination of a high-pressure gas burner with an unusual type of gas mantle. This mantle is capable of withstanding ordinary weather conditions and does not need the protection that is given by glassware. Gas at a pressure of approximately 80 in. water gauge is supplied to an adjustable ejector at the back of a burner box. On this box are screwed specially prepared gas mantles, which are supplied in the unburnt condition and strengthened to withstand severe treatment. When first lighted each mantle shrinks rapidly and eventually forms a small hemispherical source of light of great brilliancy.

The sign, A.P.L.E. CONFERENCE, consisted of a number of rectangular boxes, on one surface of which a series of holes was drilled, and into each of these a brass nozzle or stud was screwed. The combination of the holes on each box is such that by replacing studs by nozzles, or vice versa, any desired letter or numeral may be obtained. Thus, by using a comparatively small number of these boxes a large variety of words or sentences may be formed.

neglect of the remainder of the road—a condition that certainly did not make for good visibility. He contended that the eye was the final judge of installations, and that in order to gain its verdict one should give less attention to test-point illumination and more to the general illumination and to improved visibility.

Allowances for Depreciation.

Reference was also made to the 50 per cent. depreciation allowed in the B.S.I. specification, which the speaker suggested should not be more than 25 per cent. or 30 per cent. at most. Both gas and electric lighting could be maintained to this standard. More attention should be devoted to maintenance in contracts—he mentioned cases where the quotation allowed for cleaning lamps only three times a year or once every two months. In this connection an instructive table was presented, showing how the absorption of glass left uncleaned for seventeen weeks had practically doubled—from 9.5 to 18.2 per cent. Looking at this table in detail one could see the influence of the weather—in one period of two weeks the increase was only 0.2 per cent, but in another as much as 3.2 per cent.

Mr. Winstone emphasised the great benefit to public lighting of engineers having available good photometers. He urged all responsible for public lighting to have this equipment, "the most valuable piece of apparatus a lighting engineer can have," available, and to use it.

Public Lighting a "Man's Job."

In conclusion the President declared that the profession of lighting engineer was a fine one, a man's job, and one of the finest a man can undertake. He recalled that there were over 1,000 municipal councils interested in public lighting. The Association should not be satisfied until each one of these authorities had its representative on its membership roll.

The Application of Modern Electric Lamps to Street Lighting

by G. H. Wilson

This paper falls naturally into two portions, dealing (I) with the Lighting Installation and (II) with New Lamps and Fittings. In Part I the production of a "natural" effect and the effect of height and spacing with various types of fittings are discussed. Part II deals firstly with lanterns for existing lamps and secondly with some of the newer lamps (such as those burning horizontally, the new h.p. 80 watt and 125 watt types, and lamps equipped with luminescent powder) and fittings for use therewith.

Part I.—The Lighting Installation.

The relation between "appearance" and visibility" is now undergoing study. It is not certain that an increase in visibility will always result from an improvement in appearance. But "unnatural appearance" is almost certain to have a prejudicial effect on visibility—especially when non-existing objects appear in the field of view or, conversely, existing objects somehow escape observation! Mental association naturally plays an important part in assisting the recognition of objects. Lighting should enable *the form* of a road or objects upon it to be seen. As an example of failure in this respect the author presented a photograph of a central unit giving a bright patch of light in the centre of a roadway but doing nothing to reveal the nature of the adjacent area of the roundabout which the motorist must negotiate.

Effect of Position, Mounting Height, and Spacing on Appearance of Roadway.

These introductory remarks led to an analysis of the influence of position, mounting height, and power of sources on the appearance of an installation. Fittings with "non-cut-off" distributions and "cut-off" types were examined in turn.

Dealing first with the non-cut-off type of fitting, Mr. Wilson demonstrated a most ingenious method of building up representations of actual effects in a street. This is based on the use of photographs, prepared in the manner described recently before the Illuminating Engineering Society by Mr. R. G. Hopkinson, which are projected on a screen, the brightness being adjusted as nearly as possible to those actually prevailing in the street. After such a picture has been obtained for the first lighting unit in view, a corresponding one for the second unit is obtained. There are thus two pictures which may be superimposed. By swinging the projector sideways it is possible to vary the distance between the bright areas until they coalesce so that the road surface appears without so-called "shadows" or dark patches. The relation between the distance of a fitting with the effective width of the angular width of the bright area formed by the unit can be determined.

Combined Images of Roadway.

In the original paper the author shows, one above the other, combined images of lighting by units at 200 ft. and 300 ft. from the observer, giving a satisfactory and an unsatisfactory (uneven) effect. Curves connecting the effective angular width of bright area with distance of unit, and producing (a) substantially uniform appearance of the roadway, and (b) just tolerable unevenness, were derived. These can be readily applied in planning installations. By trial and error the correct positions for units so as to give the desired effect at important viewpoints can be found. The more distant viewpoints usually call for slightly closer spacing, but, provided the conditions are correct when the observer approaches to about 400 ft., a little departure for greater distances is not very vital.

Suggestions for Spacing.

From such investigations useful conclusions may be drawn. For instance, on curved roads the lighting units should be placed on the *outside* of the curve at bends of the road. On straight roads units must be mounted near the kerb line if the sides of the road are not to appear too dark. Central suspension with units having a non-cut-off distribution on all but narrow roads of less than 25 ft. in width tends to leave dark regions near the kerbs. With sources mounted at the side of the road as indicated the spacing per row of units should not exceed 300 ft. in order that the highway may have a sufficiently natural appearance; with excessive spacing bad shadows are cast by large vehicles, and the increased absorbtion with distance has a prejudicial effect in hazy weather. For distances of 100 ft., 200 ft., and 300 ft. the maximum width between pairs of opposite sources is 25 ft., 24 ft., and 21 ft. As a general guide it is safe to say that the width between rows of sources should not exceed 30 ft., and for road widths up to this value kerb mounting is desirable—an incidental merit being that this increases the contrast of the dark vertical face of the kerb and its lighter top. On wider roads an overhang is desirable, and for roads exceeding 40 ft. to 45 ft. in width a third row of sources in the middle of the road is expedient.

Effect of Change of Height.

The effect of height of fittings on brightness-distribution was illustrated in the original paper by a series of diagrams showing brightness contours for fittings at heights of 18 ft. and 25 ft. The impression produced at curves and influence on glare was also

discussed. Reducing height tends to increase a glare, where it exists. The author, however, expresses doubt whether, in any good modern installation, the the effect of glare on visibility is of any magnitude, though a certain amount of discomfort glare and distraction may be sometimes experienced.

Cut-Off Fittings.

The experiments previously described, involving the superimposing of images of lighted roadways, were also applied to cut-off fittings. Measurements with a number of motor-cars suggested that the cut-off effect of the top of the windscreen was rarely more than 15° above the horizontal. It is suggested, therefore, that a fitting designed to yield practically no intensity at angles greater than 15° (i.e., 75° to the downward vertical) gives the desired effect. With such fittings, mounted 25 ft. high, dark bands are apt to be formed across the road with spacings greater than 120 ft. Such "cross-banding" by a series of light and dark areas results in an unnatural appearance, and in practice an even shorter spacing than that above, is desirable. A spacing of 90 ft. is, in fact, a common figure. On carriageways, with rougher surfaces than the asphalt used in these tests, satisfactory lighting might be obtained with a spacing somewhat in excess of 120 ft., but it should be recalled that in course of time such surfaces tend to wear smoother. Unless a cut-off installation is to cost many times as much as a non-cut-off one, a single row of units, centrally spaced for most effective lighting, is all that can be considered. Under dry conditions such an arrangement may give good results, but when the road-surface is wet there is a tendency for the brightness of the middle of the road to be increased and for that at the sides to be diminished.

Choice between "Cut-Off" and "Non-Cut-Off" Types.

Personal preference naturally determines to some extent the choice between cut-off and non-cut-off fittings. But, in general, it may be contended that for a given light output per unit length of road a good cut-off installation will not give such high road-surface brightness, nor, on the average, such high contrasts between objects and their background as a good example of the non-cut-off type. On the other hand, the low intensity of the fitting in the direction of the observer and the inconspicuous nature of the cut-off fitting are sometimes considered good features. Building fronts and hedges also appear to be relatively well lighted by this system. But units with an effectively low cut-off must be spaced near together (no more than 120 ft. apart) if light and dark cross-banding of the roadway is to be avoided—and this involves increased capital and running costs. By keeping to the above spacing and using the 400-watt mercury lamps brightnesses comparable with those ruling in existing 250-watt non-cut-off installations may be obtained.

Power of Sources.

It is almost impossible, at the moment, to determine experimentally the lowest level of lighting at which an installation has a "satisfactory" appearance. There are, however, great variations in the power of the sources used. Installations using 500-watt filament lamps, 250-watt h.p.m.v. lamps, or 150-watt sodium lamps can give satisfactory results. Installations using 750 to 1,000-watt filament lamps, or 400-watt h.p.m.v. lamps are even less open to doubt. But installations using 300-watt tungsten lamps will frequently not give satisfaction. If an average spacing of 150 ft. is assumed an initial light-output of 5,000 to 13,000 lumens per 100 ft. of road is desirable.

Conclusions.

In terminating this section of the paper the author states the following conclusions:—

(i) *Spacing with "Non-Cut-Off" units* on straight roads should not exceed 300 ft. per row of fittings, i.e., 150 ft. in a staggered installation. Units should be arranged on both sides of the carriageway, unless this is less than 25 ft. in width, when central suspension may be used. On bends the units should be located on the *outside* of the curve, and their position determined by the "departure" angle between them as described in the original paper.

(ii) *Spacing with Cut-Off Equipment* should not exceed 120 ft. and central suspension will usually be required.

(iii) *Width Between Rows of Sources* on straight roads should not exceed 30 ft. On roads of this width or less, kerb mounting is desirable. On wider roads an overhang sufficient to bring the distance between units down to 30 ft. should be adopted. On roads of width greater than 40-45 ft. more than two rows of sources are necessary to give good uniformity. An occasional central source helps to give adequate brightness in the centre of the road.

(iv) *Mounting Height* should not be less than 25 ft.

(v) The *Initial Light Output* of lamps should be between 5,000 and 13,000 lumens per 100 ft. of road.

The "Silhouette Effect"

This picture illustrates the appearance of Christchurch Road, Folkestone, illuminated by 400-watt OSIRA electric discharge lamps, arranged for horizontal burning and installed in specially designed G.E.C. "cut off" lanterns arranged at a mounting height of 25 ft., with a 90 ft. spacing. Attention may be drawn to the evident manner in which the figures on the left stand out in silhouette against the bright road surface.

Recent Developments.

In the final section of the paper Mr. Wilson reviewed recent developments in street lighting units as a result of the introduction of new lamps. Lanterns may be roughly divided into those adapted respectively for vertical and horizontally burning lamps. A feature in connection with the latter is that, owing to the use of glasses with higher softening points, the lamps can be burned horizontally without the need for a magnetic deflector. This now applies to lamps of the 250-watt size. Convenient types of cut-off lanterns for use with horizontal lamps have been devised.

Of special interest is the introduction of 80-watt and 125-watt h.p.m.v. operating respectively at 32 and 40 lumens per watt. In these lamps the percentage of red light increases materially from 1% to 2%, as compared with the ordinary type. Lanterns for use with these new and compact lamps closely resemble those available for filament lamps, though, owing to the nature of the source, the design of prismatic surfaces may need adjustment. The

An Imposing Street Lighting Installation

A view of the Shorncliffe road, Folkestone, which was lighted during the period of the Conference by 150-watt "Philora" sodium electric discharge lamps in various types of lanterns, all equipped with Holophane Refractor Panels. This was a combined display in which the Brighton Lighting and Electrical Company, Ltd., the Engineering and Lighting Equipment Company, Ltd., Holophane, Ltd., and the Wardle Engineering Company, Ltd., all participated, with the support of Philips Lamps, Ltd. This fine residential avenue has a carriageway 50 ft. in width, in the main heavily bordered by trees. Accordingly central suspension with a double row of fittings 12 ft. distant from the kerbs was adopted. Each span supports two sodium lamps. The average spacing of the spans is 125 ft., and the mounting height approximately 24 ft. The form of prismatic refractor control selected gives a very wide lateral distribution of light. The iso-foot-candle diagram showed a maximum illumination of 1.5 foot-candles, and a minimum of 0.4, and the visibility was considered exceptionally good.

300-watt "dual" lamp, comprising a filament lamp in series with a h.p.m.v. lamp, is similar in construction to the familiar 500-watt lamp of this type, and has an initial efficiency of 21 lumens per watt.

The most novel development is the 400-watt lamp equipped with an outer cover coated with luminescent powder. In this "isothermal" outer bulb of relatively large dimensions the drawback of the powder losing its efficiency owing to unduly high temperature is overcome. Any absorption of visible light by the powder is compensated by the additional light obtained by luminescence, the initial efficiency, 37 lumens per watt, being the same as for a clear glass outer cover, whilst the "red-ratio" is improved from 1 % to 5-6%. The powder acts as a secondary source of light and the concentration of the light is thus influenced. With the usual simple prismatic arrangement the maximum intensity may thus be decreased by 40-50%, but if special fluted prismatic glass surfaces are adopted the difference may be reduced to 20-25%.

Discussion.

Mr. Wilson's paper was illustrated by excellent demonstrations. The display of the method of superimposing photographs of effects due to individual lamps, of the downward deflection magnetic of the column of vapour in discharge lamps burned horizontally, and of the appearance of lamps with fluorescent outer bulbs (the latter two items achieved by throwing an image on the screen by means of a concave mirror) were most effective.

The discussion was necessarily curtailed, but some interesting points were raised by Dr. English, especially in regard to the definition of a "cut-off" fitting, and the extent to which demonstrations with superimposed lantern slides illustrated actual practical conditions. Mr. R. Maxted emphasised the importance of high mounting, i.e., 25 ft., in diminishing glare, and remarked that, at the low order of illumination usual in street lighting, the improvement in colour gained by the use of fluorescence was not so evident as when the general order of brightness was higher. Mr. J. F. Colquhoun emphasised the value of correct planning, and urged that Local Authorities should employ a competent lighting engineer provided with an adequate staff and a properly equipped laboratory. He suggested that 120 ft. was too great a distance for cut-off fittings.

Some Further Experiments on Street Lighting

By S. English and E. Stroud

Clear Vision the Essential Aim in Street Lighting—Visibility Tests should reproduce actual conditions—Brightness and Glare increase together at very Oblique Angles—75 degrees the Limiting Angle—Tests on a Model Roadway — Determination of Percentage Visibility and Glare Index—Comparative Data for Filament, Mercury and Sodium Lamps—Confirmatory Tests in Westminster—Drawbacks of the Overhang — Lighting Unidirectional Tracks.

This paper consisted partly in an extension of the researches recently described before the Illuminating Engineering Society and recorded in these columns.*

In their opening remarks the authors pointed out that the ideal in street lighting is not the production of uniform illumination nor high surface brightness, nor the elimination of glare—all good objects in themselves but only means to an end, namely, the production of conditions such as enable the road user to *see clearly, distinctly, and easily along the roadway.*

Measurements of Visibility.

To assist in assessing this condition some means of measuring visibility is needed. Various instruments have been proposed, but it appeared that none really answered requirements. In particular, the test should be applied under actual conditions under which the eye operates—it was not possible, for instance, to use an instrument which shielded the eye from glare or limited the field of view to a restricted area of the roadway. Visibilities should be measured and determined by the unaided eye in just the same way as obstructions are ordinarily seen on the roadway.

The lighting engineer has to consider many different factors—the relative importance of which varies according to the nature of the road studied, and, by judicious compromise, to weld them into a satisfactory lighting scheme. In towns, general illumination permitting people and things to be seen by direct vision is of importance, whilst silhouette vision, enabling objects to be seen at a distance, may be of secondary importance. On roads connecting towns, the needs of fast-moving traffic must be met by providing silhouette vision. Generally speaking, the greater the contrast between a relatively dark object and the bright roadway behind it, the easier it is to see the object. Road surfaces, however, usually possess mixed reflection properties—they reflect some light specularly and some diffusely.

Glare and Brightness.

In this connection the authors presented a graph showing how quickly the surface brightness of a dry macadam surface increases when the angle of incidence increases to 85°-88° from the normal. Light striking the road-surface at a very oblique angle is thus largely instrumental in building up the desirable brightness, and should at the same time assist visibility, but for the fact that the glare simultaneously produced by these high beams greatly reduces the sensitivity of the eye. The curves connecting road reflection and glare with the angle between the source and the line of vision follow a very similar course. The glare, however, does not seriously impede vision until the eye light reaches the eye at angles exceeding 75° with the vertical.

Tests on a Model Road.

In the next section of the paper the authors described the "model road tests," as explained in the earlier paper before the Illuminating Engineering Society, and assembled typical results in the form of diagrams. It will be recalled that this model road was 100 ft. long (corresponding to an actual length of 333 yd.). The carriageway was 7 ft. wide (corresponding to 35 ft.), and was flanked by two pathways of dark stone colour, each 1 ft. wide (corresponding to 5 ft). The surface of the road consisted of dark grey asphalt with a reflection factor of 8 per cent. corresponding to an ordinary road surface.

The tests included (1) illumination readings at regularly spaced points, (2) tests of visibility based on observation of a brass disc 5 in. in diameter with a projection at one point on its surface. This disc was mounted and spun at intervals so that the projection, which had to be identified, came to rest in different positions. In addition, photographs of the roadway showing the conditions of brightness were taken. In the diagrams assembled these photos. are reproduced, and full details of illumination and particulars of the installation, including a view of the lighting unit, are included.

In a corresponding set of tables the illumination data, the percentage visibility, and the glare index are tabulated. Figures for visibility are based on the proportion of cases in which the position of the projection on the disc could be seen, and the "Glare Index" on the relative visibility with the light sources respectively shielded and in full view of the observer. Confirmatory evidence of the influence of glare is afforded by a diagram comparing the visibility (a) with the units exposed to view, as in ordinary practice, and (b) with the light sources screened from view. A marked feature of the curves is the rise in percentage of visibility when the angle of the main beam exceeds 75° for screened sources, whereas for unscreened sources there is a marked fall from that point onwards.

In the next section of the paper attention is drawn to the lack of comparative data regarding the performances of filament, mercury, and sodium lamps, for (a) equal wattages, and (b) similar lumen output. This the authors seek to supply by a series of tests conducted in a street in the Westminster area set apart for the purpose. This had a fairly polished asphalt surface and embodied five lamp-posts arranged in staggered formation with a uniform spacing of 153 ft. The width of the road was approximately 38 ft. 6 in.

Distribution of Visibility on Roadway.

The results of these tests, carried out by methods similar to those pursued in the model street, are assembled in the accompanying table. It is difficult, within the space available, to follow the authors' complete analysis of these results, but several interesting facts emerge, notably, the tendency to low visibility down the near side of the road, a condition ascribed to the combined effect of: (1) a 5-ft. overhang, (2) fairly well-polished surfaces, and (3) camber. It does appear, in fact, that the influence of this last factor has not been sufficiently appreciated hitherto. The authors, having had similar experience on the less important off-side of the road, question the expediency of a 6-ft. overhang, such as was recommended in the Interim M.O.T. report. Some rather unexpected results are recorded. For example, the most uncomfortable units in regard to glare were

* "Light and Lighting," May, 1937, p. 127; Trans. Illum. Eng. Soc., London, Vol. II., No. 6, June, 1937.

ESSENTIAL DATA DERIVED FROM TESTS.

Staggered Arrangement. Spacing 153 feet. Height 26 feet. Overhang 5 feet.

Lamp and Fitting.	500 w. Filament 160° Dome refractor.	125 watt H.P. Mercury.				150 watt Sodium.	
		180° Prismatic reflector.	160° Silvered reflector.	160° Reflector-refractor.	160° Dome.	Enamelled Trough.	Prismatic Panels.
Illumination Data—							
Angle of max. beam ...	72 5°	65°	70°	72.5°	75°	55°	77°
Cut off	Virtual	Virtual 85°	Absolute at 90° Virtual abt. 85°	Virtual	Virtual	85°	Virtual at 90°
Test Pt. Ill'n (f.c.)	.117	.080	.085	.076	.074	.13	.201
	.117	.078	.070	.052	.080	.14	.206
Diversity ratio... ...	21	8.7	11	7.5	10	19	7
% Visibility—	(a) (b)	(a) (b)	(a) (b)	(a) (b)	(a) (b)	(a) (b)	(a) (b)
Near side (a)	44 38	26 26	42 24	30 24	34 32	32 13	41 44
Middle Shielded	80 96	96 96	96 98	98 98	94 94	94 96	94 96
Offside (b) Not	48 46	50 36	36 24	34 34	54 38	38 34	40 46
Av. full width Shielded	57 60	57 53	58 49	54 52	61 55	55 52	59 62
Reduction in visibility due to glare (a-b) ...	3% (increase)	4%	9%	2%	6%	3%	3% (increase)
Glare Index—							
Direct light from fittings	.104	.057	.006	.059	.064	.003	.180
Reflected light from road and houses ...	.010	.011	.004	.010	.006	.0015	.025
Direct—Reflected ...	10.4	5.2	1.5	5.9	10.7	2	7
Remarks	Overhang 1′ 6″ only	No contrast at 2 points	No contrast at 3 points	No contrast at 1 point	No contrast at 3 points	No contrast at 3 points	

those using opaque reflectors (silvered glass and white enamel)—one disconcerting factor being the intermittent nature of the glare. It is also curious to note that certain installations apparently gave a somewhat better visibility when the units were exposed than when they were screened!

The Lighting of Unidirectional Tracks.

A final problem studied by the authors was the lighting of unidirectional tracks. Here, it is suggested, the aim should be to direct as much light as possible towards the oncoming driver—which is just the opposite of that recommended on the Continent—though evidently in applying this scheme special effort should be made to avoid glare. For such installations the authors have built up experimental units by cutting directional dome refractors and reflectors in half and putting the halves together (one half refractor and one half reflector), so that both project the light in the same direction. With a spacing height ratio of 6:1 one could produce a practically uniform brightness of the road-surface, with a visibility on the model roadway over the near side and middle of the roadway of 81 per cent., and for the middle of the road only of 96 per cent. Applied to the test roadway the average visibility over the whole of the test area was 75 per cent., which was considered a very satisfactory figure; whilst the fact that the "shielded visibility" was 77 per cent., or only 2 per cent. higher, shows that the effect of glare was small.

More recently the scheme has been applied to a two-track bypass road (Hangleton Road), near Brighton, 150-watt sodium lamps being used. The appearance in the direction of travel was excellent, and visibility readings of 100% down the near side of the road and the middle were obtained.

Discussion.

This paper gave rise to a lively discussion, in which Mr. G. H. Wilson, Mr. F. C. Smith, Mr. J. M. Waldram, and other experts took part. Mr. Wilson pointed out that the experiments at least encouraged the belief that the glare from well-designed installations based on a variety of different methods was not serious, and that no very marked differences in visibility arising from the variation in colour of light yielded by filament, mercury, and sodium lamps were to be noted.

Mr. F. C. Smith, in an excellent contribution, agreed that measurements of illumination or road-brightness *alone* gave no good criterion of excellence. The essential point was "to see easily and clearly," but how far could "static" observations be applied to moving objects? He drew attention to the danger that visibility tests might give different results according to the precise method of test. It seemed, for example, that the test object was not large, and it might possibly be considered that the authors were testing acuity (which involved the perception of fine detail) rather than visibility. Apart from the influence of glare on visibility tests, there was no doubt that glare that was actually disconcerting did occur in practice, sometimes in streets with "lumens to spare." Returning to the question of tests of visibility, Mr. Smith urged the need for a clear understanding of what this term conveyed—he deprecated, for example, the use of such unscientific tests as observing the street surfaces through strips of dark glass! In conclusion, he made two very pertinent observations in regard to the paper. He suggested that, interesting as the paper had proved, it might not be expedient to draw conclusions in regard to general principles of street lighting until they had been confirmed, not on one but on many roads. He also drew attention to the case in which 100% visi-

bility had been recorded, and inquired what degree of visibility would be recorded if the conditions were still further improved!

Other comments were made by Mr. J. M. Waldram, who remarked that the author's test was based on what one couldn't see, and which was thus in effect a test of "invisibility," and Mr. F. X. Algar, who described some tests that were being made on an experimental mile of road in the Irish Free State, involving comparisons between filament and discharge lamps and tests of a special cut-off unit. He also emphasised the fact that quality must ultimately be referred to the judgment of the eye—what was wanted was "a pair of good eyes and an open mind."

In replying very briefly to the discussion, Dr. English explained that the authors did not attempt to draw too general conclusions from these tests, the results of which were only comparable one with another. He thought, however, that the test was, if anything, more severe than practice, because fixed objects were more difficult to detect than moving ones. Horizontal burning lamps had proved advantageous from the standpoint of limiting glare. He agreed that a scientific definition of visibility was greatly needed—that was a problem with which the Illuminating Engineering Society were occupied. Another point that needed consideration was the desirable distribution of brightness on the roadway. It was generally agreed, for example, that brightness on the near side was more important than elsewhere; but how much importance, relatively, should be attached to the brightness of other regions?

High-Intensity Gas Lamps

By G. Keith

In this paper the author described a most novel and interesting form of low-pressure gas lamp, for which an efficiency comparable with that associated with high-pressure lamps is claimed. This result is secured by the aid of U-shaped tubes, which act as syphons and straddle the bracket, or other means of suspension, so that they are not too conspicuous when lamps are mounted 25 feet high. One important feature of the device is that the lamps are substantially wind-proof.

This paper, whilst difficult to abstract on account of the somewhat complex technical descriptions involved, was one of considerable scientific interest, dealing as it did with an important departure in low-pressure gas lighting.

In the introductory part of the paper the author explained that modern incandescent gas lamps of the inverted mantle type operate on two distinct principles. In the one case the air-gas mixture contains only a proportion of the oxygen that is required for combustion, a secondary supply being required to complete combustion of the gas on the outer surface of the mantle fabric. In the other case the oxygen required for complete combustion is mixed with the gas, the heat produced by its combustion being liberated wholly within the mantle. With the first system a secondary supply of air to the mantle is essential, but with the second system this is unnecessary and even detrimental — owing to its cooling effect. The paper dealt only with lamps operating on the second principle.

Special Methods of Increasing Intensity.

When all the products of combustion are passed through the meshes of the mantle the brightness of of the mantle and the amount of light produced from a given volume of gas are increased. It is practically impossible by natural methods to produce a mixture of gas and air so rich in oxygen as to burn completely within the mantle at the ordinary main pressure (4 in. water), and some source of energy in addition to that available in the low-pressure mains is needed. In the familiar high-pressure system a compressor increases the pressure of the gas to about 80 in. water. The high-pressure gas must be distributed through independent pipes. This may be considered in some degree a drawback, though, in fact, the system is very widely used and no serious difficulties are experienced.

Other methods of obtaining high-power lighting have been tried, such as the supply of air through special pipes under a small head of pressure, and the use of a small electrically driven fan applied to each unit. The latter device, devised by Humphreys in America, has also been tried on a small scale in Edinburgh; but there are few cases in which there is sufficient co-operation between the local gas and electric undertakings to permit of its general adoption. There is, however, an alternative system, which is now being applied in a new form of lamp exhibited at the meeting.

Some Recent High-Pressure Lamps.

Before describing this the author illustrated some typical modern high-pressure lamps, using gas at 3 lb. pressure from the high-pressure main. The main features of such lamps were pointed out, such as the means of adjusting the quality of gas and air mixture, and the heating of this mixture by the hot gases leaving the incandescent mantle. This device also serves to keep the nozzle cool by conducting away the heat to the body of the heater through which the mixture passes. An important feature is the apparatus for eliminating eddying and turbulence, such as is apt to increase any tendency for the flame to strike back. The metal gauze in the nozzle provides the final precaution in this direction. In low-pressure lamps it is ordinarily necessary to provide for a flow of secondary air into the globe, but in the later high-pressure lamps it has been found preferable to draw the air supply direct from outside.

Flat Bag Mantles.

Reference was next made to the important modification in the shape of the incandescent mantle made by the South Metropolitan Gas Company, the mantle, shaped like a flat bag, being arranged so that the flat surfaces face up and down the street, giving most of the light in the direction in which it is mainly required. With this device there is an increase in flux of light beyond that given by the ordinary cylindrical mantle, which the author ascribes to the fact that the mantle can be fixed closer to the underside of the heater so that the latter receives more heat by radiation and flame contact. The mixture, passing through a very narrow slit, is more highly heated throughout than is possible in the final stage of heating with a cylindrical nozzle; the narrowness of the

slit also increases the margin of safety against lighting back.

Other features described included a form of high-pressure unit for floodlighting purposes, two of which were used to supplement the low-pressure floodlighting of the Pavilion Hotel.

A New Low-Pressure High-Intensity Lamp.

In the final section of the paper the special new lamp already mentioned was described. The origin of this is to be found in the intensified Lucas lamp used in the days of the upright mantle, in which a long chimney was used to give a "pull" on the burner and thus to create a more highly aerated combustible mixture. The Lucas light, whilst successful indoors, was found to be somewhat sensitive to wind. The advent of the inverted mantle and burner caused the Lucas upright lamp to be superseded. The principle was not applied with success to inverted burners, at least so far as outdoor lamps were concerned.

The recent application of this principle to inverted burners, however, whilst yielding encouraging results for indoor lighting, again revealed difficulty in securing steadiness in the open air, a slight wind having a disturbing effect. A different method of causing the secondary air to enter the space between the tubes was then tried with success. This is in effect a device which *pushes* the secondary air into the space instead of pulling it through by the suction of the chimney. This arrangement enabled a lamp that is wind-proof to be developed.

The details of this lamp, which were described at the meeting, are difficult to follow without a full description and lettered diagrams. In proximity to the mantle is a bunch of small tubes fed by a mixture of gas and air having as high a proportion of oxygen as can be obtained from the low-pressure gas injector which feeds the adjacent chamber. Surrounding this chamber are two other chambers connecting to the space between the small tubes. The problem is to cause the secondary air to enter this space against the resistance of the mantle and without the pull of a chimney. Surrounding the chimney body of the lamp is an outer chamber similar to that used with the ordinary low-pressure lamp. This is not connected with the globe, so that, contrary to the usual practice in low-pressure lamps, no secondary air is allowed to enter it. This chamber, however, connects with two uprising tubes, which are bent at the top and return downwards forming syphons. The pressure difference set up by these syphons is unaffected by the wind. In a modified design the central chimney is divided, but in either case the syphon tubes are arranged to straddle the bracket so that their length does not count in the length from the point of suspension. At first sight the tubes present an unusual appearance, but when the lamps are in position with the mantles 25 ft. from the ground they are not obtrusive.

Performance of the New Lamps.

Six of these lamps, each equipped with four mantles and consuming 45 cub.-ft. per hour, were placed in Marine-terrace and Lower Sandgate-road, just opposite the Conference Hall. Six other lamps of a smaller pattern, with divided chimneys and three mantles, consuming 30 cub. ft. per hour, were mounted in Radnor Park-road.

It is, the author suggested, generally accepted that the light output of a good low-pressure lamp, using gas at 500 B.Th.U., is about 200 lumens per cub. ft. of gas, and that the light from a good high-pressure lamp is about 350 lumens per cub. ft. A recent independent test of the lamps just described gave an output of 300 lumens per cub. ft.

Discussion.

The above paper and that by Mr. Dean Chandler (see page 292) were discussed together, but the discussion naturally turned largely on the new lamps described by Mr. Keith. A well-deserved congratulation was given to Mr. Keith for his original work, in which great difficulties had been overcome. Mr. F. C. Smith, in emphasising this point, explained that the lamp really was a low-pressure lamp, burning on the ordinary mains pressure, and suggested that the length of the syphon-tubes might be considerably reduced in new designs.

The keenest discussion raged round the output ascribed to the lamp. Mr. J. N. Waite urged that there should be a clearer understanding in regard to the meaning of "candle-power" as applied to gas lamps (i.e., whether in one direction, mean spherical or mean hemispherical) and that mean hemispherical candle-power was not a satisfactory basis of comparison. Values should be expressed in terms of the total output of light in lumens.

Mr. W. J. Jones dealt with the same point and presented figures derived from tests on certain lamps carried out at the National Physical Laboratory. A lantern containing three mantles, each nominally of 1,500 c.p., showed a mean spherical candle-power of 1,563, which corresponded with 216 lumens per cub. ft. of gas for the entire fitting. In the case of a lantern with the block type of mantle, 276 lumens per cub. ft. per hour were found. Mr. K. F. Sawyer disputed these figures, stating that the figure of 350 lumens per cub. ft. given in the paper included all absorption due to accessories. He invited Mr. Jones to visit Watson House and check the measurements there, whilst the latter asked Mr. Sawyer to investigate for himself the N.P.L. results.

Public Lighting with Gas

About 520 lamps are covered by a renewal of the contract in the Houghton-le-Spring Urban District. Contracts have also been renewed for Mountsorrel, covering 254 lamps and Edenbridge (a three-year agreement).

About 1,915 lamps are covered by a recent contract made by the Stockton-on-Tees Corporation.

A ten-year agreement for gas lighting has been entered into by the Cheslyn Hay Parish Council. Costs of contemplated improvements will be spread over a period of several years.

Twelve-light gas lamps, recently installed in Johnstone, have proved so satisfactory that the corporation is to extend the new lighting.

During the last ten years the number of gas lamps used for public lighting in Edinburgh has increased from 9,843 to 22,842, an increase of 132 per cent. The corresponding annual gas consumption has risen by 91 per cent.

Considerable improvements in the gas lighting under the recent ten-year contract for a part of Southwark provide for the installation of "Supervia" lamps and about 170 additional light-points. Part of the lighting is by low-pressure and part by high pressure.

A seven-year contract for the lighting of Dudley, Brierley Hill and district, has been concluded with the local gas undertaking. It covers 1,959 lamps and provides the replacement of 615 old-type lamps with a modern lamp of a higher candlepower.

Whaley Bridge Urban District Council has decided that the streets of Whaley Bridge shall be lighted by gas. The total number of lamps in the district is now 172.

New contracts for street lighting by gas include the villages of Bingham and Stokesley, Kingswood, Clare, Milford, and Witley (Surrey), Hilperton and Staverton (Wilts), which are the subject of new five-year agreements specifying improvements and additions to the present installations.

Other contracts include: Oundle, the villages of Anstruther, Crail, Pittenween, St. Monans, Kelty (Fife), Heglay, Framlingham, South Molton (Devon), Great Cornard, Long Melford, Grantham, Kinglassie and Cardenden (Fife), Greatham, Bottesford, and Markyate.

Street Lighting by Gas

With Special Reference to the High-Pressure System

By Dean Chandler

Mr. Dean Chandler's paper served a useful contrast to some of the other more highly technical contributions. It reviewed progress in a general manner, with occasional touches of humour. There was no ground for the fear expressed in his introductory remarks that "it may not be sufficiently controversial"—in the constant clash of ideas and systems in connection with street lighting a paper that does *not* raise controversy is sometimes a welcome relief!

Mr. Chandler claimed, with justice, that the gas industry, which for over a century has been associated with the civic life of the community and has served it well, deserves some consideration at the hands of public bodies. He recalled that half a century ago the death sentence of gas lighting had been pronounced, and he reproduced two amusing early cartoons conveying this idea. That gas lighting is very far from dead, and that there has in fact been steady progress, was illustrated by a map showing the miles of streets in London that are gas lighted, and by a table picturing advances during the period 1899-1936. During this period the equivalent candle-power per hour has increased from 280,000 to 5,104,000, and the candle-power per cubic foot from 2.5, with flat flame burners, to 42.5 with modern high-pressure gas lamps.

It was pointed out that the term "high pressure" is comparative only. At first 1½ inches of water was regarded as a suitable pressure. Then three inches became general, and subsequently pressure was increased by various mechanical contrivances, as exemplified in the Scott-Snell, Lucas, and other special lamps. A great advance took place when Mr. George Keith introduced the now familiar high-pressure gas lamp, which ultimately made it possible to obtain 50 to 60 c.p. in the horizontal plane for each cubic foot of gas burned. Such lamps were first exhibited at the Franco-British Exhibition in 1908.

Two years ago there was an interesting and important departure—the Supervia lamp, with its rectangular mantle, which helped very considerably towards getting better distribution of light and avoiding the "pools of darkness" resulting from uneven lighting. In this connection Mr. Chandler presented isolux curves for the installation of these lamps in South London, showing a minimum of 0.22 and a maximum of 1.0 foot-candles. He drew attention to one advantage of high-pressure lighting—the ease and rapidity with which all lamps can be turned on or off during an emergency by the simple process of starting or stopping the compressor.

A map of the South Metropolitan Gas Company's high-pressure mains system, showing the various compressor stations, was instructive in displaying the immense area now covered. The high-pressure system includes, in all, about 119 miles of pipe, corresponding with about seventy-three miles of roads thus lighted. A feature has been the introduction of the system on roads which have changed their character, carrying much more traffic and requiring higher illumination than before. Pictures of a number of typical installations were presented, one prominent example being Blackfriars-road, where Supervia lamps are centrally suspended. This road, like the Borough High-street, Southwark, is a "Class C" installation, and in Lewisham, Greenwich, Southwark, and Lambeth there are a number of roads in the "Class D" and "Class E" categories.

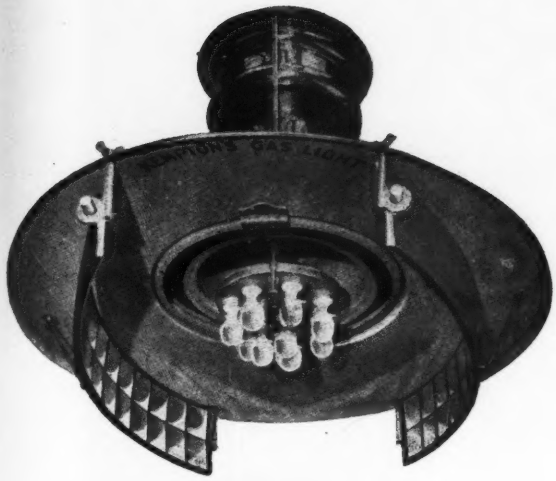
The high-pressure system uses a pressure of 81 in. water column, or approximately 3 lb. per sq. in. In appendices to the original paper details of the Keith Rotary Gas Compressor and raising and lowering gear for suspension lamps are given

A notable feature in South London is the development of extra "parade lighting," chiefly paid for by private traders who recognise the attractive power of good lighting. The intensity of the lighting is illustrated by the fact that in one of the newer installations of this kind an illumination of 2.72 foot-candles, as compared with 0.64 from the public lighting alone, is provided.

Gas Lighting in Clifton-gardens

The picture above shows a view of Clifton-gardens, Folkestone, which was lighted by eight 12-light "Maxill G" low-pressure gas lamps, furnished by Messrs. W. Parkinson and Co., mounted 25 ft. high and spaced 130 ft. apart. The lamp utilises a pair of burners (each comprising three to six mantles) fitted at the foci of facetted paraboloid reflectors of anodised aluminium. The reflectors are adjustable, both in the vertical and horizontal planes—the former serves to allow for variation in spacing, the latter for varying road-widths and bends in the road. Each reflector is also separately adjustable so that the effect of gradients can be considered. The conditions of illumination in Trinity-gardens and Clifton-road, where these lamps were installed, were considered equivalent to Class "D" in the British Standard Specification. These lamps are recommended for the lighting of main thoroughfares and arterial roads. A second type of lamp, the Brimax type "Maxilla" lamp, makes use of a facetted butterfly-wing reflector and embodies a swan-neck as an integral part of the lamp—an arrangement which permits a greater mounting height to be obtained than with the ordinary type of suspension fitting. This form of lamp is intended for residential thoroughfares. In general appearance it closely resembles the Maxill lamp, so that by adopting both types an extensive area can be treated in uniform style.

MODERN GAS PUBLIC LIGHTING UNITS



"MAJESTIC"

The "Majestic" 10 or 12-lt. suspension lamp, with "Multiplane" reflectors, is an attractive unit suitable for central suspension and bracket arm main road installations, conforming to Classes F, E, or D of the B.S. Specification for Street Lighting.

The reflectors are capable of adjustment in situ and thereby permit the best conditions of road brightness being obtained for any particular type of surface.

In addition to efficient performance as directive devices, the reflectors also function as cut-off fittings, enabling the high road brightness to be coupled with the minimum of glare.

For secondary roads, the "Kemborn" lamp, with "Multiplane" reflectors, is available. In appearance similar to the "Majestic" but of smaller build, the "Kemborn" is eminently suitable for suspension in swan necks on short columns. The lamp accommodates 3 to 6 mantles in cluster or line formation.

Engineers having installations using lamps similar to either of the above types, but without directional equipment, can be supplied with sets of "Multiplane" reflectors and fittings, which can be very easily attached to the enamelled iron reflectors.

"STARLYTE"

This modern lighting unit is of value to the lighting engineer when the subject of illuminating residential roads is being considered.

Of simple and rigid construction, a built-in, accurately designed mirror system projects a high flux of light axially along the road sides and on the sidewalks, ensuring adequate illumination for pedestrians and motorists alike. Permanency of focussing, often not attained in the older forms of square lanterns where auxiliary devices are used, is assured by the mirrors being cemented in the actual top casting.

Maintenance, an important item in these days of competitive lighting schemes, is simplicity itself, cleaning being carried out quickly, the absence of metal or glass projections in the body of the lamp enabling the lamp attendant to work with the maximum of ease and safety.

Available in two sizes, having from 2 bijou to 4 medium mantles in line.

Full details about the above lamps and reflectors will gladly be supplied on request, and to those interested in the possibilities of the above equipment we offer our co-operation in the designing of new installations or the modernising of old ones.

C. H. KEMPTON & CO., LTD.,
STANGATE HOUSE,
235, WESTMINSTER BRIDGE ROAD, LONDON, S.E.1
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A "Cut-Off" Gas Lighting Installation in Cheriton Gardens

Photo: Hobbs, Offen and Co., Ltd., Victoria-street, S.W.1. *Courtesy: "The Gas Journal."*

The installation illustrated above was in some respects one of the most interesting at Folkestone. It utilises the new "Folkestone" lamps of Messrs. Wm. Sugg and Co., Ltd. Each lamp is fitted with six No. 2 size mantles arranged in cluster formation, and is of the "total cut-off" variety. The lamp incorporates a special design of blown glass reflector manufactured by Zeiss. There is a total cut-off at approx. 86 deg. downward. The angle of maximum candlepower is ordinarily located at about 68 deg., though this angle can be varied within limits in order to suit the road reflection characteristics and the spacing height ratio.

The average spacing in this case was 75 ft., and the height of the lamps, mounted down the centre of the road, 21 ft. The width of the roadway is 25 ft. The minimum illumination measured in a horizontal plane was found to be 0.35 foot-candle (except in the case of one or two spans of 89 ft., where 0.25 foot-candle was recorded), and the maximum illumination 1.4 foot-candles. The diversity co-efficient was thus only 4:1.

The appearance of the roadway confirmed the evenness of the illumination, the degree of uniformity being good. The absence of glare from the "cut-off" fittings was also the subject of favourable comment, and the installation excited a considerable amount of interest. One noticeable feature was that whilst objects on the roadway were seen in the usual way, by silhouette, persons on the footway at the sides of the road were seen, and quite well seen, by the illumination they received. Both methods of making objects visible in the streets were thus represented.

Recent Developments in Low Pressure Gas Street Lighting

By F. C. Smith and K. F. Sawyer

This paper proved a useful adjunct to the display of street lighting in Folkestone. Details of the chief gas lamps exhibited and installations were given.

The authors remarked that there is no unique form of distribution of light from lanterns to meet all situations. Gas lantern manufacturers accordingly furnish a wide range of units. Important advances have, however, been made during the past year. The criterion of effectiveness of lighting is really the *visibility*, but many factors—distribution, intensity, mounting height, position, etc.—all contribute their effect. Other important items, such as the effect of the road surface, depend greatly on weather conditions. At present no simple relationship between the brightness of an object and its background can be formulated. Nor is it possible to decide upon any one factor as an adequate index to the effectiveness of an installation. Failure to recognise this fact has led to some adverse criticism of the present B.S.I. specification.

After briefly summarising the main conclusions of the M.O.T. Committee's interim report, the authors emphasised the importance of a high standard of maintenance, such as has been demonstrated in a report recently issued by the Institution of Gas Engineers. Many gas companies are now prepared to maintain lighting installations within 20 per cent. of the initial values, a standard that does not involve excessive expenditure, as modern mantles have a life of about 2,000 hours without any marked diminution in light output, and heat-resisting glassware has an average life of two years.

From this point onwards the paper reviewed lighting units and installations. The first described was

"Majestic" Lamps in Manor Road

Photo: Hobbs, Offen and Co., Ltd., Victoria-street, S.W.1. *Courtesy: "The Gas Journal."*

The installation here presented makes an effective picture. The Manor-road was lighted by Messrs. C. H. Kempton and Co., Ltd., with 12-light "Majestic" lamps equipped with Multiplane projectors, which are capable of adjustment *in situ* so as to obtain uniform illumination with varied spacing. This installation falls into "Class D" in regard to illumination, and the picture gives a good idea of the even spread of brightness over pavement and roadway. The mirror glass reflectors used with this lamp, which are arranged in the form of a divided ring on either side of the mantles, have a useful cut-off effect on rays slightly below the horizontal, and thus suppress glare. Another interesting form of lamp (the "Starlyte"), produced by Messrs. C. H. Kempton and Co., Ltd., utilises an arch of mirrored surfaces above the mantles. This lamp, which is intended for rural areas where greater spacing is usually necessary, was also on view at Folkestone in Shakespeare-terrace.

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the "London" lantern by Messrs. William Sugg and Co., Ltd. The mantles are arranged in line and a series of adjustable reflectors enable the distribution of light to be varied considerably. Iso-candle diagrams and true-representation photographs for several streets, lighted by these units, on which contour lines of equivalent foot-candles are superimposed, were presented. Another photograph showed the results of mounting lamps on the outside of bends, as recommended in the M.O.T. report.

The "Majestic" lamp of C. H. Kempton and Co., Ltd., the "Maxill" lamp of Messrs. Parkinson and Co., Ltd., and the "Arcturus" of Foster and Pullen, Ltd., were dealt with in a similar way.

The other two lamps dealt with were the new Keith high-candlepower low-pressure lamp, which is stated to yield 15,000 lumens from the four-light size on a pressure of 5 in. w.g., an increase in efficiency of 50 per cent. beyond that hitherto obtainable with low-pressure lamps—and the new H.V. lamp with Zeiss mirror reflectors introduced by William Sugg and Co. It will be recalled that the latter is a cut-off unit furnishing an axial beam between 60° and 70°, and directing an exceptionally high proportion of the total flux of light on the road surface. The weight of the lamp, for a given output, has been much reduced, so that two or even three lamps can be suspended on a single span wire.

In the discussion of the above paper Mr. A. R. McGibbon urged the need for a clearer understanding of the minimum necessary illumination on roads. The aim should be to light as many as possible reasonably well, rather than a few to a very high standard. Mr. J. M. Waldram alluded to recent work on visibility and deprecated the distinction between theory and practice as though they were two distinct things. Mr. T. A. G. Margary emphasised the point that light emitted in the lower hemisphere was what was mainly of importance in street lamps. Mr. J. K. Brydges asked for more information on the relative value of vertical and horizontal light sources. Mr. C. A. Masterman testified to the correctness of the figures for light output, etc., given in the paper. He also urged that street lighting should not be "over simplified," and should not be assessed in terms of one particular factor alone.

Mr. F. C. Smith, in reply, agreed that a judicious spreading of money available for street lighting was expedient, but thought that no general yardstick could be used at the present time. The total output of light from a lamp was important, but also the distribution. High posts were not always necessary; carefully planned short-post installations could do quite useful work. "Side-street lighting" might well form the subject of a paper next year. He thanked Mr. Masterman for his assurance in regard to figures quoted. Naturally, since data obtained in the laboratory formed the basis for contracts every care would be taken to see that they were accurate.

Planned Street Lighting

By T. Catten, R. Maxted, and G. S. C. Lucas

This paper served as an introduction to a most entertaining film display. The authors point out the variety of factors contributing to the result in street lighting—the choice of the lighting unit, the mounting height, spacing and position of units—all interdependent items that must be considered in planning the installation.

In presenting lighting installations, and especially those in the streets, to an audience a number of difficulties arise. The relative position of observer, light-source, and objects lighted is of great importance, and it is expedient that each member of the audience should have the same viewpoint. Moreover, it is difficult, in the streets, to change the viewpoint quickly to 300, 600, or 1,000 ft. away in succession. Conditions change rapidly and may be altered by sudden rain, mist, or snow. Models, again, are difficult to handle, unless presented to each member of the audience in turn. Still photographs and lantern slides give the common viewpoint and permit the point of observation to be changed quickly, but even this medium is not entirely satisfactory.

It is in this field that the cinematograph film proves so useful. The common viewpoint can be changed quickly or slowly, and the film can reproduce transient conditions. Animated cartoon photography opens up a further field for development.

The use of the camera on the road itself is limited to daylight photography owing to the natural limitations of the medium. Such films, taken in daylight, may be useful in illustrating the importance of backgrounds and other general problems, and some films of this character were shown during the A.P.L.E. Conference of 1935.

But the problem of taking satisfactory films of street lighting at night has proved almost insuperable owing to the long exposure necessary, the changing conditions whilst films are being taken, and the difficulty of locating the camera accurately for successive views—to say nothing of the interference caused by the headlights of passing cars and other practical difficulties.

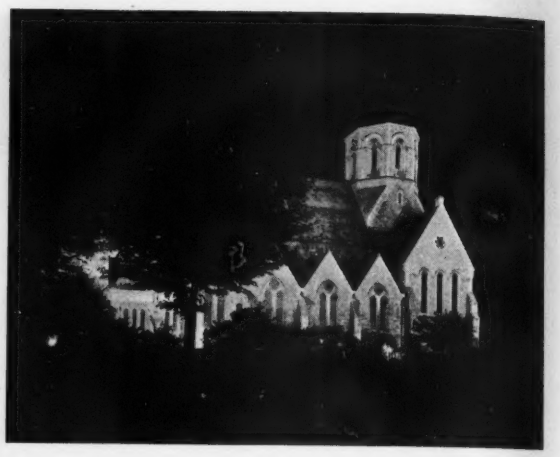
These considerations led the authors to attempt instead the taking of films in a studio where there is absolute control during a series of exposures. Conditions observed on the road were reproduced on a model in the studio. Attention was confined to qualitative results, and with this limitation reasonably successful results were soon obtained.

The two films shown dealt, first with one or two fundamental problems in principles in street lighting (and in particular the correct location of the lantern unit with respect to the road surface). The vast differences in the quality and intensity of indoor and outdoor lighting respectively were illustrated. The difference between the plan view of a lighted road and the appearance of the same road to an observer standing on the roadway, were shown. The films also showed how bright backgrounds are produced and the importance in this connection of correct placings of the lanterns.

A second film showed, in greater detail, how the characteristics of the lantern are linked with the condition of the road surface and the lay-out of the installation.

The treatment of the problem in the actual films was most ingenious and showed how much can be done by the aid of models in building up a demonstration of this kind. Salient features of an installation were first displayed. It could be seen, for instance, how a car, almost indistinguishable against a dark background, sprang into view when a white fence (built up in sections before the eyes of the audience) appeared, as if by magic, how confusing and obscure may be the effect of wrongly placed sources when a road curves, and how greatly the conditions are improved when the lighting units are replaced on the *outside* of the bend. After a series of views in detail the audience were taken by the film on a continuous tour of the whole route.

Holy Trinity Church Floodlighted



Holy Trinity Church, Folkestone, floodlit for the A.P.L.E. Conference by means of horizontally-burning 400-watt standard high-efficiency Mercra Lamps in B.T.-H. Mazdalux Floodlight Projectors.

Lighting in the Sandgate Road

One of the B.T.-H. street lighting demonstrations in Sandgate-road. This installation employs horizontally-burning 400-watt standard high-efficiency Mercra Lamps in the new and improved B.T.-H. Mercra "H" Lantern. The units are mounted at a height of 25 ft., and are spaced 150 ft. apart in staggered formation.

The unit answers well at distances between lamps of 150 ft., and the rectangular light-distribution is specially suitable for the lighting of wide thoroughfares.

"Revo" Lighting at Folkestone

The above installation, in Cheriton-road, consists of ten "Revo" lanterns, equipped with Philora 400-watt mercury lamps. The fittings embody prismatic and lenticular glass panels, with internal stainless steel reflectors to ensure the best distribution of light. Units are mounted 25 ft. high and 138 ft. apart. The illumination is of Class "D" standard.

"Revo" fittings with sodium 150-watt lamps were also installed in Alexandra Gardens.

Electric Street Lighting

Manchester.—During the 1936-37 lighting period, 699 additional electric lamps were connected.

Norwich.—The last section of the improved street lighting was switched on in September last. It utilises a total of 4,397 lamps (a load of 595 kW) and conforms throughout to Class "B," "C," and "D" of the B.S.S. It is estimated that only two years ago over 95 per cent. of the streets did not conform to Class "H" of the B.S.S.

Isle of Axholme.—The road lighting to be totally electric. 455 lamps are involved and the scheme is to be completed by March, 1939.

Clayton-le-Moors.—The Urban District Council have approved electric lighting the whole installation.

Derby.—The electric street lighting is expected to be completed by the end of 1938. The completed installation will consist of 4,563 street lamps, 330 to light traffic islands and 206 for road refuges.

Mytholmroyd.—2¼ miles of the Bromley road have now been relighted. The new installation of sodium discharge lamps links up with the road relighted by Hebden Bridge Urban District Council. Now four miles of the road are uniformly lighted. The installation conforms to Class "E" of the B.S.S.

Bristol.—Colour-corrected high-pressure mercury vapour lamps are to be installed for street lighting; this is believed to be the first instance of lamps corrected by means of fluorescent powders being used on a commercial basis.

Dartmouth.—The offer of the Urban Electric Supply Company for the public lighting has been accepted. The contract recently concluded covers a period of fourteen years with a break clause for termination at the end of seven years.

Other recent installations of electric lighting units include:—

Tungsten Filament Lamps.—Brynamman (70), Cam, Gloucestershire (21), Eling, Southampton, Camborne-Redruth, Margate.

Mercury Vapour Lamps.—Troon (110).

Sodium Discharge Lamps.—Newton-in-Makerfield (76), Bury, Lancs (68).

Street Lighting Developments in Deptford

An interesting event on October 6 was the inauguration by the Mayor of Deptford (Councillor Horatio A. Waldegrave) of the new lighting scheme in Deptford. This, when completed, will be the largest street-lighting installation of high-pressure mercury vapour lamps in the Metropolitan area and the largest in the world employing the new 80- and 125-watt discharge lamps. The thoroughfares are being divided into four classes: (a) main thoroughfares; (b) through-traffic routes; (c) secondary roads; and (d) residential roads—and lighted accordingly. Approximately 2,000 lamps are being installed. The lanterns for the 250-watt and 400-watt lamps are of the familiar G.E.C. "Fulham Di-fractor" type. A specially designed smaller lantern of the same variety is being used for the 80-watt and 125-watt lamps. Units are mounted 25 ft. high in main thoroughfares and through-traffic routes, and 18 ft. in secondary and residential roads, and are, in general, spaced 150 ft. apart.

Pomeroy Street. Illuminated by 250-watt mercury vapour electric discharge lamps in "Fulham" Di-fractor lanterns. (Wet night.)

Musgrove Road. Illuminated by 80-watt Osira lamps in specially designed lanterns. (Dry night.)

Automatic Control of Street Lighting

Whilst lighting units—especially the new gas lamps—figured prominently at the Folkestone Conference, on one aspect of public lighting—methods of control—not much was said. We are reminded of this point by some recent literature issued by Radiovisor Parent, Ltd., whose automatic system of control based on the use of light-sensitive cells is applied not only to the control of public lamps, illuminated guardposts, and pedestrian crossings, but to many industrial processes. One of the most striking applications, to our mind, is for the automatic switching on of artificial lighting in offices when the "grumble point" arrives. Similarly, street lamps are automatically switched on when daylight fails or in the event of a fog—whenever, in short, their need becomes apparent. We recall that the application of the system in Sheffield was mentioned in the recent report of the public lighting engineer of that city.

Further Notes on Exhibits at Folkestone

In addition to the lamps and lanterns which "caught the eye" at Folkestone, the very considerable amount of supplementary equipment should not be forgotten. We may mention, for example, that the steel columns round the Royal Pavilion Hotel were supplied by Bromford Tube Company, Ltd. They had varying designs of ornamental brackets, but were all of the types which are proving popular both for gas and electric lighting. There is ample room in the base for all necessary gear, and these tubular steel columns are eminently suitable for installations in accordance with the recommendations of the Ministry of Transport.

For a number of installations, e.g., in Clifton-crescent, Trinity Gardens, Radnor Park-road, etc., the "Wask" up and down lamp suspenders of Walter Slingsby and Co., Ltd., were in operation. The patent hook introduced this year is a useful innovation.

The part played by mantles should also be remembered. We understand that a large proportion of those used on the exhibition lamps were of the Welsbach type (of the Lighting Trades Syndicate), which, we understand, are made in the largest gas mantle factory in the world.

A moulded spiderless type of mantle was exhibited at the Conference by Messrs. Falk Stadelmann and Co., Ltd., whose "Veritas" mantles were used in Radnor Park, Cheriton Gardens, and other installations, including the floodlighting of the Royal Pavilion, the headquarters of the Conference; whilst their special "Fire Glow" mantles are in use for the floodlighting of the Kingsnorth Gardens.

The Perception of Light

Readers will find elsewhere (see p. 298) an announcement of a series of six lectures on the above title, to be delivered by Dr. W. D. Wright at the Imperial College of Science and Technology (South Kensington), at 5 p.m., on successive Thursdays, commencing November 4.

We strongly commend this special series of lectures on vision not only to students but also to those engaged in practical illuminating engineering. Behind all lighting problems—and public lighting in particular—there is the fundamental problem of defining and assessing visibility. In street lighting, also, the behaviour of the eye vision at low intensities and the reaction of the eye to glare—both topics which Dr. Wright treats in detail—are of great importance.

We cannot recall a similar series of lectures in the past. The complete syllabus with which Dr. Wright has favoured us shows that he intends to make a special feature of the application of the study of vision to such problems as the lighting of streets and factories, cinemas and studios, and to television. The final lecture on recent researches reviews many modern investigations, such as those of Weston, Hopkinson, and others, with which members of the Illuminating Engineering Society have recently been preoccupied.

Lectures on Illumination at the South-East London Technical Institute

Another instance of the greater attention being devoted to illumination at technical institutions occurs at the South-East London Technical Institute, where Mr. J. B. Harris, one of the younger members of the I.E.S., has been appointed a visiting teacher. At this institution illuminating engineering figures in the grouped courses for electrical demonstrators, electrical installation, and cinematograph operators. The course now initiated consists of a series of lectures, each to occupy from 8.15 to 9.45 p.m. on successive Friday evenings, and covers a wide field. After the usual preliminary treatment of photometry, fundamental principles, planning installations, etc., practical lighting problems of all kinds (lighting of homes, factories, streets, churches, etc.), and such special topics as aerodrome lighting, lighting for publicity, floodlighting, etc., will be discussed.

Yorkshire Council for Further Education

We learn with interest that Mr. J. W. Howell, the honorary secretary of the North Midland Area Local Centre of the I.E.S., and Mr. J. F. Colquhoun have been invited to collaborate with the Advisory Committee in connection with projected courses on illumination in the Yorkshire area, and that there is a prospect of such courses being arranged in Leeds and Sheffield.

Literature on Lighting

(Abstracts of Recent Articles on Illumination and Photometry in the Technical Press)

(Continued from Page 261, September, 1937)

II.—PHOTOMETRY.

252. Measurement of the Luminous Flux of Projectors.
J. Rieck. Licht und Lampe, No. 16, p. 383, August 12, 1937.

The characteristics of epidiascopes, lanterns, and small film projectors are stated, and a method of measuring the luminous flux thrown on the screen, which enables the optical efficiency of different types to be compared, is described. If all unavoidable failures and tolerances are taken into account, an accuracy of 12 per cent. is attainable by this method. H. L. J.

253. The Light Sensitive Cell.
R. H. Mighell. G.E. Rev., 8, pp. 372-375, August, 1937.

Describes the construction and performance of a light sensitive cell consisting of a layer of selenium deposited on a metal plate, and covered by a transparent layer of conducting metal. The cell requires no external source of energy, and is said to be very sensitive. Charts showing the effects of illumination, resistance, and temperature are given. J. S. S.

254. Plotting Curves of Equal Brightness.
M. R. Nampom. R.G.E., 42, No. 2, pp. 67-70, July 17, 1937.

The author calls attention to the importance of brightness in describing a public lighting installation. A graphical method of construction for brightness contours is described. W. R. S.

255. A Possible Basis of Measurement for Lighting Installations.
D. Matonovic. R.G.E., 42, No. 9, pp. 259-264, August 28, 1937.

Suggests a method of measuring the overall value of a lighting installation. The method involves characterising the lighting effect at a given point by the effect on a small sphere surrounding the point. W. R. S.

III.—SOURCES OF LIGHT.

256. Luminous Sources.
A. C. Atherton. R.G.E., 42, No. 6, pp. 175-181, August 7, 1937.

Deals with modern developments in electric lamps and in particular with incandescent filament lamps, some of the particular advantages of which are described. W. R. S.

257. Crypton-filled Incandescent Lamps.
H. Péchaux. R.G.E., 42, No. 5, pp. 131-136, July 31, 1937.

Variation of efficiency with voltage is studied. It is stated that crypton filling is particularly satisfactory for lamps below 100 watts. W. R. S.

258. The Production of Daylight-coloured Light by Discharge Lamps.
A. Claude. R.G.E., 42, No. 6, pp. 181-183, August 7, 1937.

Modern developments in discharge tube lighting to produce good colour-rendering are discussed. W. R. S.

259. New Bipost-Base Street Series Lamp.
Anon. Elect. Engineering, 56, p. 863, July, 1937.

A brief description, with photograph, is given of a new tungsten filament lamp being introduced in America for series street lighting. S. S. B.

IV.—LIGHTING EQUIPMENT.

260. Design of Lighting Apparatus.
R. Pagès. R.G.E., 42, No. 7, pp. 195-211, August 14, 1937.

The formulae due to Blondel are discussed, and their application to reflector and refractor design dealt with in detail. W. R. S.

261. No Glare from these Glasses.
V. E. McCallum. El. World, 108, p. 720, August 28, 1937.

To avoid glare from light reflected from the cover glass of instruments on a switchboard a specially-shaped cover, composed mainly of a transparent plastic, but with an inclined front glass, has been designed. This permits illumination of the scales, and clear visibility of the scale and pointer, without any glare from bright reflections. S. S. B.

262. Technical and Economic Advantages of Using Very Low Voltages for Lighting Purposes.
L. Morati. R.G.E., 42, No. 6, pp. 185-186, August 7, 1937.

Deals with installations of the order of 20 V., and gives comparative tables indicating the gain in efficiency of the low-voltage lamp over 160-V. lamps. Increased strength and other factors are also dealt with. W. R. S.

263. Voltage Regulation.
"E.O.T." Elect., 119, p. 267, September 3, 1937.

The effect of voltage regulation on consumption, life, and efficiency of lamps is discussed. Diagrams are given. C. A. M.

264. The Proper Use of Light.
Anon. El. Rev., Vol. cxxi., No. 3120, L. 336, September, 1937.

Describes the latest reconstructions and improvements at the E.L.M.A. Lighting Service Bureau. These include the use of fluorescent powders in decorative panels. R. G. H.

V.—APPLICATIONS OF LIGHT.

265. The Amelioration of Visual Tasks.
M. L. Schneider, R.G.E., 42, No. 8, pp. 241-245, August 21, 1937.

Deals with principles of good lighting, showing their application to general lighting and also to some special inspection probems. W. R. S.

266. Schools Become Field Laboratories for Lighting.
Anon. El. World, 108, p. 689, August 28, 1937.

A report is given of some extensive experiments in an American school to determine the best lighting for classrooms. These experiments included the determination of the best colours for the walls and ceiling, and for the blackboard and chalk, as well as intensity and lay-out of the lighting installation and system of control. S. S. B.

267. Some Practical Experiments in School-room Lighting.
J. Gaunter and C. Schedler. R.G.A., 42, No. 8, pp. 245-247. August 21, 1937.

Describes in some detail an installation in which artificial lighting was made, as far as possible, to be similar to natural (window) lighting. W. S. S.

268. Experiments on School-room Lighting at Basle.
H. Hofstetter. R.G.E., 42, No. 8, pp. 247-249, August 21, 1937.

Describes experiments conducted in different types of class-room, e.g., gymnasia, tailoring shops, etc. Photographs are given. W. R. S.

269. Lighting in Auditoria.
Anon. El. Times, 92, p. 228, August 19, 1937.

The lighting in two large cinemas is discussed and photographs are given. W. R. S.

270. Bank Lighting Aided by Projection Units.
Anon. El. World. 92, p. 228. August 19, 1937.

In order to provide adequate lighting of the tellers' cages, accounts files, and clerks' desks in an American bank, without interfering with the architectural features of the hall, a special method of lighting, using high intensity projectors from the ceiling, was adopted. Some details and a photograph are given. S. S. B.

271. Concert Hall Lighting.
Anon. Elect., 119, p. 216, August 20, 1937.

A description, with photograph, is given of the lighting equipment of the Concert Hall at Bridlington. Cove lighting is used extensively. C. A. M.

272. Cinema Lighting.

Anon. Elect., 119, p. 244, August 27, 1937.

The lighting equipment of a new cinema at Stockport is described with a photograph. C. A. M.

273. Application of Discharge-tube Lighting to Interiors at Lausanne.

P. Meystre, R.G.E., 42, No. 6, pp. 184-185, August 7, 1937.

Describes, with diagrams, the lighting of a restaurant and a bank at Lausanne. W. R. S.

274. New Street Lights Win Public Approval.

E. C. Alexander. El. World, 108, p. 527. August 14, 1937.

Details are given of the lighting unit and layout adopted in the relighting of the main street of Pueblo, U.S.A. The unit combines a 400-watt mercury vapour lamp with a 200-watt filament lamp, the choke and condenser for the former being mounted in the fitting. S. S. B.

275. Lighting for Traffic Safety.

E. M. Rice. El. World, 108, p. 374, July 31, 1937.

The author stresses the need for better lighting of highways, giving figures on the increase of automobile traffic and of fatal accidents. He outlines a programme of attack on the problem of traffic accidents, and makes suggestions for the introduction of lighting at dangerous points. S. S. B.

276. "Sohio" Modernises with Mercury Lighting.

E. B. Karns. El. World, 108, p. 347, July 31, 1937.

Some details are given of the lighting of a petrol station, using mercury vapour lighting, supplemented by filament lamps. S. S. B.

277. Lighting Problems in Connection with Railways.

L. E. Besser. Das Licht, No. 8, August 10, 1937.

A brief summary of the main lighting problems requiring attention on railways is given, and their solution discussed. H. L. J.

278. Lighting Installation at Earl's Court.

Anon. El. Rev., Vol. CXXI., No. 3118, p. 270, August 27, 1937.

Describes the interior lighting plan of the new exhibition building at Earl's Court. The whole of the colour lighting scheme is controlled by a thyratron reactor dimmer. R. G. H.

279. Illuminations at the Paris Exhibition, 1937.

Various Authors. R.G.E., 42, No. 2, pp. 45-61, July 10, 1937.

A full account of illumination and lighting effects produced for the 1937 Exhibition of Arts and Crafts. Particular attention is paid to the effects obtained with water on and near the Seine. Photographs and diagrams are given. W. R. S.

280. "The Tour de France de la Lumière."

Anon. R.G.E., 42, No. 2, p.p. 5B-6B, July 10, 1937.

An account with photographs of special floodlighting effects. Mobile lighting units made a tour of principal monuments in France and N. Africa to demonstrate the value of floodlighting. Data on these mobile units is given. W. R. S.

281. Coronation Illuminations.

Anon. El. Times, 92, p. 165, August 5, 1937.

A set of photographs of overseas floodlighting installations are given with notes. W. R. S.

282. Southend Illuminations.

Anon. Elect., 119, p. 271, September 3, 1937.

A description with a photograph is given of the various novel effects introduced in the present illuminations scheme at Southend. C. A. M.

283. Coronation Illuminations.

Anon. El. Times, 92, p. 203, August 12, 1937.

Gives a number of photographs, with notes, of floodlighting installations. W. R. S.

Recent Patents

(Abstracts of recent Patents on Illumination & Photometry.)

No. 468,643. "Improvements in or Relating to Extra-High-Pressure Metal Vapour Electric Discharge Devices."

The General Electric Company, Limited (Communicated by Patent-Treuhand Gesellschaft für Elektrische Glühlampen m.b.H). Dated January 22, 1936.

This specification deals with high-pressure vapour discharge lamps in which the pressure exceeds 10 atmospheres, and has for its object the prevention of condensation of the vapour upon electrode leads where they are sealed to glass capillaries of side tubes.

The leading-in wire is sealed through the end of a glass capillary extending outwardly from the main vessel and joined to the quartz envelope by one or more bodies of intermediate coefficient of thermal expansion. The portion of the leading-in wire projecting into the main vessel is closely surrounded by a sheath of refractory insulating material—quartz, for example.

No. 468,805. "Improvements in Sources of Infra-Red Radiation."

The General Electric Company, Limited (Communicated by Patent-Treuhand Ges. für Elektrische Glühlampen m.b.H.). March 24, 1936.

According to this specification near-infra-red light radiation in the region between, say, 7,500 Å and 10,000 Å is produced by a discharge lamp filled with a mixture of rare gas and caesium vapour, the operating vapour pressure of the latter corresponding to a temperature between 80° C. and 140° C. Mainly two resonance lines are produced at 8,521 Å and 8,943 Å respectively. The rare gas pressure should be high, but not so high as to cause much radiation of visible light; it may be between 5 and 15 mm. for example.

No. 468,822. "Improvement in Starting Circuit for Gas or Vapour-filled Electric Discharge Devices."

Vanovia Chemical and Manufacturing Company, May 23, 1936. (Convention, U.S.A.)

According to this specification an automatic starting circuit for a discharge device operating on low voltages and connected in series with a stabilising impedance comprises a two-way electro-magnetic switch adapted, when not energised, to connect its winding in series with a condenser across the discharge device and, when energised, to connect its winding in series with an impedance, such as a condenser, across the stabilising impedance, the arrangement being such that when power is supplied to the circuit the electro-magnet of the switch is energised intermittently until a discharge is initiated and is then continuously energised during the discharge.

No. 468,982. "Improvements in and Relating to Electric Discharge Lamps."

The British Thomson-Houston Company, Limited, and Fairbrother, J. A. V. April 16, 1936.

This specification relates to the high-pressure constricted arc type of discharge lamp in which the imput per inch length of arc is about 1,500 watts and the voltage per inch length is about 1,200. The pressure developed within the envelope of such lamps is about 2,000 lb. per square inch. The envelope is of quartz or other highly refractory material. According to the specification there is arranged between the two electrodes a refractory element having between it and the inner wall of the envelope a structurally formed helical passage through which the arc is constrained to pass. Thus a rod or tube may be wound about the refractory element or, alternatively, the latter or the inner wall of the envelope may have a screw thread. The refractory element may be hollow and fluid cooled.

No. 469,187. "Improvements in or Relating to Gas-Filled Electric Discharge Devices."

The General Electric Company, Limited (Communicated by Patent-Treuhand Ges für Elektrische Glühlampen m.b.H.); January 22, 1936. January 4, 1937. (Cognate Applications.)

This specification has for its object the operation of gas-filled discharge devices without a stabilising impedance or the equivalent, and depends upon the fact that the positive column part of the discharge does not necessarily have, as hitherto believed, a negative or falling characteristic. The specification is only concerned with discharge devices in which the voltage drop in the positive column forms a substantial part of the total voltage drop. The diameter of the envelope of the device, the nature of the main electrodes and the distance between them, and the nature and pressure of the gas filling can be, and are according to the invention, so related that the overall voltage-current characteristic has, at least over some range, a rising or positive form. The rising characteristic of the positive column outweighs the falling characteristic of the cathode drop.

No. 469,913. "Improvements in or Relating to Combinations of Electric Discharge Devices and Materials Excited to Luminescence by the Electric Discharge."

The General Electric Company, Limited, and Randall, J. T., February 7, 1936. (Divided from No. 469,732.)

According to this specification a source of white light comprises a discharge lamp with a filling adapted to emit either the low-pressure mercury spectrum or the neon spectrum and a luminescent material which is, or contains as its main constituent, zinc tungstate in monoclinic form which is activated to emit blue light.

No. 469,732. "Improvements in or Relating to Combinations of Electric Discharge Devices and Materials Excited to Luminescence by the Electric Discharge."

The General Electric Company, Limited, and Randall, J. T., January 27, 1936.

According to this specification a white light discharge lamp has a filling emitting either the low-pressure mercury spectrum or the neon spectrum and a luminescent material which contains, as a main constituent, magnesium tungstate in monoclinic form which is activated to excite blue luminescent light.

ILLUMINATION ON BOARD SHIP

ECONOMIC USE OF CONTROLLED LIGHT

By G. V. DOWNER

SHIPOWNERS are much troubled by the high and increasing costs of shipbuilding, while, on the other hand, shipbuilders are finding it more and more difficult to reduce their costs, or even to prevent them from rising, and at the same time to meet the owners' requirements. This in some measure is due to the high standards of luxury, decorative quality and numerous facilities of all kinds demanded by the owners and necessitated by international and general competition.

The purpose of this article is to show that in the matter of lighting, at all events, it is quite possible, by employing the latest methods, to have both efficiency and luxury, including all the decorative or special effects that may be desired, without excessive first cost, and usually with a reduction in running costs. The latest methods, which thus combine effect and efficiency with economy, are based on the recognition of the fact that good lighting is not simply a question of the number and intensity of the lamps, as so often seems to be assumed, but depends on the control and distribution of the light from each lamp, the correct placing of each lamp for the best effect, the proper co-ordination of the individual lamps with each other and with all the reflecting surfaces of the room, including ceiling, walls, floor and furniture, and the correct choice of fittings in conjunction with all the other factors.

The object of artificial lighting is not to provide a certain quantity or intensity of light as measured by instruments or according to some theory as to the amount of light suitable for various purposes, but rather to produce certain practical and desirable effects enabling us to use our eyes in the absence of daylight in much the same way as in its presence. The primary or utilitarian effect which is obviously required from all artificial lighting is that it should enable us to see all our surroundings clearly and comfortably and as nearly as possible with the same ease as by daylight.

The Question of Intensity

Another important requirement, especially on board the passenger ship, is an æsthetic effect, namely, that the lighting scheme should harmonise with the architectural or decorative features or that it should produce some special artistic or striking effect in itself. Both kinds of effect can best be judged, in fact can only be judged, by the eye.

At the same time, however, the required effects must be produced, as far as possible, without the risk of causing eye-strain or any ultimate injury to sight, and this is the only respect in which the immediate impression on the eye is not necessarily a reliable guide, in so far as the intensity may be excessive without causing any immediately noticeable discomfort. In fact, the impression of brilliance may be more attractive than otherwise at first, but the unnecessary intensity may easily produce eye-strain in the long run, particularly if the colour is not an accurate reproduction of that of daylight, as it very seldom is.

Hence it is usually preferable not to have intensities much above the minimum necessary to produce the required practical results in the way of good general visibility together with any special effects desired. In this way not only is possible damage to eyesight avoided, but there is also a saving of unnecessary expense in current consumption.

The fact that high intensities are not necessarily better than more moderate intensities, and that the question of intensity is not nearly so important as that of the quality or distribution, is well illustrated by the analogy with daylight, which is the kind of light for which our eyes are naturally designed. The intensity of daylight varies twice daily over an enormous range from practical darkness to noon sunlight and back to darkness again. Yet we can see almost equally well under all intensities between dawn and sunset. This is due to the universal dispersion and diffusion of the light in all directions, as a result of reflection and refraction by the atmosphere, clouds, and the surface of the earth, whereby every object is more or less evenly illuminated on all sides.

Distribution and Diffusion

The new methods of artificial lighting aim at reproducing this quality of daylight. Their primary object, therefore, is to obtain perfect diffusion and even distribution with practically equal intensity over the whole area, avoiding shadows or reducing them to a minimum, and avoiding glare by concealing the sources of light or rendering them as inconspicuous as possible. These results are obtained by means of various patented combinations of reflecting and diffusing devices for use with ordinary electric lamps or other normal sources of light. These devices can be applied to practically all forms of illumination, both direct and indirect, including pendant and ceiling fittings and standards, laylights, panels, artificial windows, pillars, and cornice lighting.

In the case of laylights, panels and artificial windows of the latest type, for example, the actual source or sources are concealed, and the light is evenly distributed from the whole of the glass surface, which thus acts as an apparent source of large area and comparatively low intensity. It can be looked at without glare and casts no shadows, but gives enough light and shade to enable objects to stand out and not appear too flat.

The Use of Fewer Lamps

Hitherto, for this form of lighting, it has been usual to place a number of lamps directly behind the glass which, therefore, had to be of dense opal or other heavily diffusing type in order to mitigate glare. This causes serious loss of light by absorption. With the newer methods far fewer lamps are used, and, as they are concealed and their light evenly distributed over the glass by reflectors, a much lighter or even practically transparent glass can be used. The loss by absorption is, therefore, negligible. This also enables full use to be made of many attractive kinds of decorative glass, figured or coloured, or both, and the beauties of such glass are particularly well displayed owing to the angle at which the light strikes the glass, catching the facets and making them sparkle.

An important and striking feature of this system is that it enables uniform distribution to be obtained over an unusually large area from a single light source, thus greatly reducing the number of points required in any particular case. This results in many economies, not only in the first cost of bulbs and the simpler wiring, but also in bulb renewals, maintenance, and, above all, current consumption. A saving of current consumption is of particular value to shipowners, as it not only reduces the cost of current but also greatly simplifies the heat problem, often so difficult of solution, especially on ships sailing in tropical waters. There is, therefore, additional saving in the cost of installing numerous heat extractors, cooling plant, etc. Valuable space is released in this way and also by the simpler wiring and fewer spare bulbs to be carried.

Cleaning is easier and quicker, and, moreover, the reduction of heat militates against the accumulation of dust and dirt, points which will be welcomed by the shore maintenance staff at a "turn round" when time is so important. Extensive economies can also be effected in the wiring system, *i.e.*, in cable, conduit boxes, lampholders, and switches, a feature which will appeal to the shipbuilder.

All these advantages can be obtained without sacrifice of variety or artistic effect. In order to take full advantage of the newer methods of lighting, it is essential that the lighting expert should be called into consultation at the beginning, before the architectural, decorative, and furnishing schemes are settled, so that these may be designed in conjunction with the lighting scheme. It should be possible, for instance, to ensure that the decorative scheme shall not look different or less effective under artificial light than by daylight.

It will be realised what artistic effects and practical benefits can be obtained, together with efficiency and economy, by the use of controlled light.

Reprinted from "The Shipping World."

Enquiries on this subject should be addressed to:
G. V. D. ILLUMINATORS, LTD., ALDWYCH HOUSE, LONDON, W.C.2. — HOLBORN 7277-8

The Illuminating Engineering Society (U.S.A.)

Notes on the Current Transactions (September, 1937)

NEWS: An association, termed the *Light for Life Foundation, Inc.*, has been established at 122, East 42nd-street, New York. Its main sphere of activities includes the promotion of safety through emergency lighting.—In order *to reduce accidents at crossings* the Chicago and North-Western Railway Company has undertaken experiments with a 2,500,000-candle-power beam device mounted on the engine above the normal headlight, casting a gyrating beam on the railroad right-of-way. This operates both by day and by night, and in daylight has been observed from a distance of three miles and at night from a distance of six miles.—*A new type of moving illuminated advertisement* has been developed. This consists of a panel, equipped with bulbs (approximately 2,000 for each 24 square yards), fixed on roofs, etc. Each lamp is in a circuit with a grid-controlled tube. A corresponding number of photocells, grouped in a field, control these tubes and are exposed to normal lantern slides, silhouette designs, or even moving pictures, by ordinary camera apparatus. In this way, practically any advertisement, static or moving, can be adapted for outside exposure by the same means as those showing advertisements in a cinema.

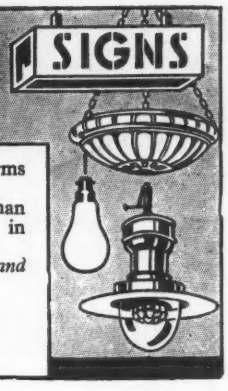
SUBJECTS OF PAPERS: *A Study of Brightness, Distribution, and Control of Classroom Lighting*, by Robert L. Dearborn. This deals with systematic experiments as to the improvement of lighting conditions in a day school for the purpose of remedying the causes which led to 18 per cent. of the pupils having defective vision. The experiments resulted in the following important claims. The contrast in ceiling brightness should not be greater than a ratio of 10 : 1. The levels of illumination on the desks must average not less than 30 foot-candles. Supplementing day light with artificial light by photoelectric control is essential. Blackboard illumination shall conform with the degree of visibility on the horizontal working plane. No part of fitting units used, visible from any point at eye level in the classroom, shall be brighter than the maximum brightness of the ceiling.

Light and Architecture in England, by Waldo Maitland. A general survey of the position of architectural lighting developments in England, containing useful statistical data relating to electricity rates, the extent of discharge tube applications, and notes on various directions of development for the chief forms of light sources. A detailed account is given of the design of the lighting equipment for the R.I.B.A. headquarters, London, which was designed by the author, and might well be considered a typical example of modern architectural lighting, illustrating the problems involved and their solution.

OFFICIAL RECOMMENDATIONS: *Standards for Lighting Sight-Saving Classrooms.* The State Department of Education, Columbus, Ohio, has notified the authorities concerned that it "will require that new sight-saving classes receiving reimbursement from the State be governed by these recommendations," which are, generally speaking, those officially made by the I.E.S. for the respective localities. *Specifications for Testing Semi-Direct and Indirect Luminaries*, issued by the I.E.S., gives details of proceedings in testing luminaries for compliance with official recommendations.

WHERE TO BUY

A DIRECTORY OF LIGHTING EQUIPMENT



We invite applications for spaces in this new section of the journal. Particulars of terms for each space (approx. 1 inch deep and 3½ inches wide) are given below.

These terms are equivalent to **half our ordinary advertising rates**, but not less than 12 successive monthly insertions can be accepted on this basis, and amounts are payable in advance.

Payment for an advertisement in this section entitles the advertiser to receive *Light and Lighting* during the period of the contract.

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12 Successive Monthly Insertions	£3 10 0	Payable
24 " " "	£6 0 0	in
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Pictures and Picture Galleries. Floodlighting, etc.
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Our Illuminating Engineers will be pleased to advise you on any street or floodlighting problem

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BROMFORD

Seamless Steel Lighting Standards

for all requirements

BROMFORD TUBE CO., LTD., ASTON, BIRMINGHAM

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COMPANY OF GREAT BRITAIN LIMITED

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Manufacturers of **X-Ray Reflectors**

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Sole Proprietors and Patentees

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"ESLA"

BI-MULTI AND MULTIPLANE REFLECTORS

Lanterns, Brackets, Columns, Switches and Fuse Boxes, etc., FOR STREET LIGHTING

The Electric Street Lighting Apparatus Co. The Foundry, Canterbury

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VITREOUS ENAMELLING

(CAST IRON & M. S. SHEET)

Cooker parts, stripped & re-enamelled. Reflectors, Lanterns, etc., for industrial & Public Lighting.

ELM WORKS Ltd., Summerstown, S.W.17. Est. 1903.

Index to "Where to Buy"

N.B.—The numbers are those attached to individual entries in the Directory (See pp. 309-311).

Gaslighting Equipment

A remarkable range of equipment is covered by some leaflets recently issued by Foster and Pullen, Ltd. The "Strip" lantern here illustrated is only one of a number of units in which mantles are assembled, the "Display" interior unit, using six or three mantles, and the "Spread" semi-floodlight, using two, being other examples. Other single-mantle units are the "Crossing" spotlight, which, as its name suggests, is intended to serve pedestrian crossings and the like, and the appropriately named "Scuttle" unit, which is a compact device for "balancing" floodlighting installations or for illuminating small objects.

The "Strip" Lantern with screen, lettered either in black on white or scarlet on white attached.

The leaflet contains several excellent pictures of floodlighting with gas, of which Messrs. Foster and Pullen have made a speciality.

Ordinary public lighting is catered for by the Gledhorn lantern and others. The firm also markets some useful accessories, amongst which may be mentioned the "Avil" anti-vibrators and the Avil "Cleanol," —the latter a medium for cleaning all types of reflectors (such as stainless steel and chromium-plated surfaces) on gas lamps used for public lighting.

Catalogues and Advertising Literature

We invite all firms in the Lighting Industry to send us new catalogues as they appear, for reference in these columns

BRITISH THOMSON-HOUSTON CO., LTD.—Catalogue of Mazda Lamps.

CHLORIDE ELECTRICAL STORAGE CO., LTD.—Catalogues of Keepalite Emergency Lighting for Hotels, Shops, Banks, etc. Also Emergency Lighting for Cinemas and Theatres and "Our Hospitals and Keepalite."

CURTIS LIGHTING CO. OF GREAT BRITAIN, LTD.—Leaflet illustrating Curtis Exterior Lanterns and X-Ray Reflectors. Also Leaflet describing Curtis Industrial Lighting Equipment.

FALK STADELMANN AND CO., LTD.—An illustrated catalogue of Efesca Electric Labour-Saving Appliances for the home.

FOSTER AND PULLEN, LTD.—Illustrated booklet, "Floodlighting by Gas," dealing with Strip Lanterns and Floodlights. Also leaflets on "Public Lighting by Gas," "The Interior Light," "Avil Anti-Vibrators," and "Avil Cleanol."

GENERAL ELECTRIC CO., LTD.—Illustrated catalogue of Wiring Systems.

MEK-ELEK ENGINEERING, LTD.—Illustrated leaflets describing local Lighting Units and Adjustable Lighting Fittings.

METROPOLITAN VICKERS ELECTRICAL CO., LTD.—Illustrated catalogue describing latest types Metrovick Electric Discharge Lamps and Equipment.

SIEMENS ELECTRIC LAMPS AND SUPPLIES, LTD.—Illustrated catalogue of Siemens Electrical Appliances —Electric Irons, Fires, Kettles, etc.

A Holophane Coronation Souvenir

A pleasing and well-illustrated brochure issued by Holophane, Ltd., contains a full-page picture showing the procession of H.M. the King leaving the Abbey after the ceremony, and the floodlighting of one of the Towers. Illustrations in colour also show the appearance of the Coronation Robes at the Royal School of Needlework, South Kensington, the lighting scheme for which was designed by Holophane Ltd.

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